高等职业教育“十三五”规划教材

机电专业英语

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内 容 简 介

本书内容针对机械、电气行业实际工作过程需要，介绍机电专业英语常用的专业词汇及术语，内容涉及机械电子学、金属切削机床、金属切削原理与刀具、机床的液压传动、机床夹具、计算机辅助设计与制造、电气元件、数控机床与编程、机床的控制元件与 PLC、计算机集成制造系统、机电产品说明书、谈判、合同及一些翻译技巧等方面的内容。每一课中都有重点讲授内容和阅读材料补充内容，阅读紧扣主题，以综述性为主。每篇重点讲授课文都附有单词注解、重点词及句子注释。最终使读者能够借助专业词典阅读、理解本专业英文资料、设备（产品）说明书，初步具备专业英语的翻译能力。

本书与基础英语有较好的衔接，文章内容覆盖面比较宽，阅读材料丰富，专业词汇比较全面，难度适当，又具有较强的实用性，适合作为机电类高职学生的专业英语教材。本书也可供机电类中职学生、本科学生及机械和电气工程专业技术人员学习参考。

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前言

PREFACE

高等职业教育院校是以为社会培养高素质、技能型人才，以注重理论与实践一体化教学为中心，以不断提高学生的动手、动脑以及手脑并用的能力为目的的。作为新世纪信息技术的专业人才，不仅需要掌握扎实的专业基础知识和基本技能，还应当具备一定的英语运用能力，而高职高专院校学生更应该注重英语运用能力的培养。因此，从高职高专院校的人才培养要求出发，我们编写了这本《机电专业英语》。

本书依照“教、学、做”一体的专业英语课程教学大纲，针对高职院校机电专业学生的基础和接受能力，内容难度适中，实用性强，力求做到“现在所学”为“职业所用”。

高职院校机电类专业英语教学以提高学生职业综合能力为目标，其主要任务是，通过教学，使学生能够掌握机械及电气方面常用专业词汇及术语，能够借助专业词典阅读、理解专业英文资料、设备（产品）说明书，初步具备专业英语的翻译能力。本书正是为适应高职院校机电类专业英语教学，满足教师和学生的教学、学习需要而编写的。

本书由专业基础篇、专业篇及附录三部分组成。专业基础篇共 5 课 10 篇文章，其中包括“机电一体化”介绍联轴器、键、轴和弹簧以及普通碳钢的退火和正火等方面的内容；专业篇共 15 课 30 篇文章，其中包括金属切削机床、金属切削原理与刀具、机床的液压传动、机床夹具、计算机辅助设计与制造、电气元件、数控机床与编程、机床的控制元件与 PLC、计算机集成制造系统、机电产品说明书、谈判、合同等内容；附录包括科技英语的特点、英语应用文的特点、英汉科技翻译基础知识、总词汇表等，可供学生和专业技术人

员进行本课程学习、机电类专业资料学习和翻译时参考。全书共 20 课 40 篇文章。为了扩大学生专业英语阅读量，使学生了解更多的专业词汇，每课除一篇课文之外，还有一篇与课文内容相关的阅读材料。

本书的教学时数推荐为 60 学时。其中，阅读材料可由教师讲授，也可由学生自学。凡在阅读材料中出现的生词均可在总词汇表中查到。教师还可根据实际教学情况，选讲部分内容。

本书由沈阳职业技术学院王素艳、武威职业学院田迎春担任主编，川北幼儿师范专科学院姚喻舒、东华理工大学刘薇、铜仁职业技术学院张明担任副主编，黎明职业大学宁歆、新疆农业职业技术学院多英学、重庆电信职业学院张洪芹、克拉玛依职业技术学院徐新民担任编委。全书由王素艳统稿审核。

由于水平所限，编写时间又很仓促，书中如有疏漏或错误之处，恳请广大读者批评指正。

为了使本书更好地服务于授课教师的教学，我们为本书配备了 PPT 课件，教学案例，教学检测及参考答案，课程标准，期中、期末考卷答案和课后习题、答案。使用本书作为教材授课的教师，如果需要本书的教学软件，可到华信教育资源网 www.hxedu.com.cn 下载。如有问题，可与我们联系，联系电话：（010）69730296/13331005816；QQ：394992521。

编　者

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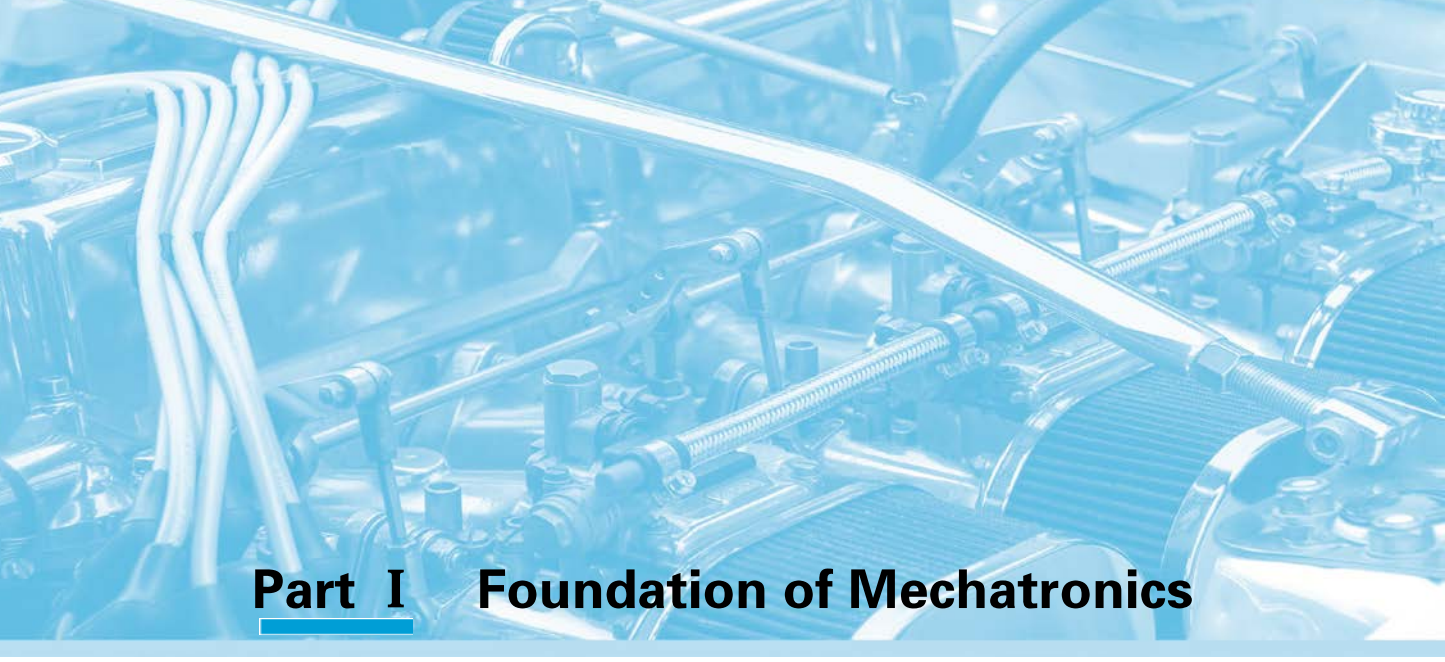


Part Ⅰ Foundation of Mechatronics

▶▶▶ Lesson 1 What is “Mechatronics”?

“Mechatronics” is a term coined by the Japanese to describe the integration of mechanical and electronic engineering. The concept may seem to be anything but new, since we can look around us and see a myriad of products that utilize both mechanical and electronic disciplines. Mechatronics, however, specially refers to a multi-disciplinary, integrated approach to product and manufacturing system design. It represents the next generation of machines, robots, and smart mechanisms necessary for carrying out work in a variety of environments-primarily, factory automation, office automation, and home automation as shown in Fig. 1-1.

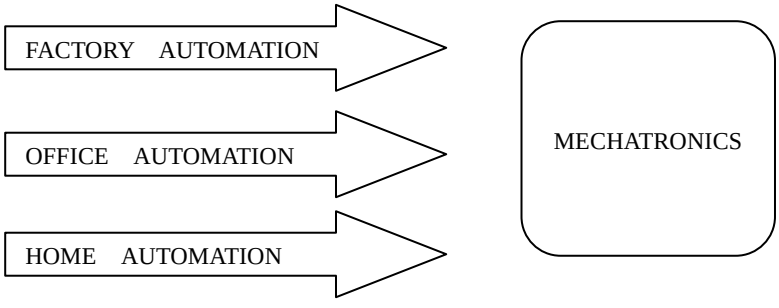


Fig. 1-1

By both implication and application, mechatronics represents a new level of integration for advanced manufacturing technology and processes. The intent is to force a multidisciplinary approach to these systems as well as to reemphasize the role of process understanding and control.

This mechatronics approach is currently speeding up the already-rapid Japanese process for

transforming ideas into products.

New Words and Phrases

1. mechatronics [mekə'trɔniks]	*n.* 机电一体化
2. coin [kɔin]	*vt.* 创造
3. integration [ˌinti'greiʃn]	*n.* 整合；一体化
4. mechanical [mə'kænikl]	*a.* 机械的；机械学的
5. electronic [iˌlek'trɒnik]	*a.* 电子的
6. myriad ['miriəd]	*n.* 无数，极大数量； *a.* 多种的，各式各样的
7. utilize ['ju:təlaiz]	*vt.* 利用；使用
8. discipline['disəplin]	*n.* 纪律；学科
9. smart [smɑ:t]	*a.* 聪明的；敏捷的
10. primarily [prai'merəli]	*ad.* 首要地，主要地
11. implication [ˌimpli'keiʃn]	*n.* 含义；言外之意
12. intent [in'tent]	*n.* 目的，意图
13. multidisciplinary [ˌmʌltidisə'plinəri]	*a.* 多学科的；包括各种学科的

Phrases and Expressions

1. mechanical and electronic engineering	机电工程
2. look around	四下观望，进行调查
3. a myriad of	无数的，各种各样的
4. refer to	参考；指的是；适用于；涉及
5. carry out	进行；执行；完成
6. as well as	也，又
7. transform…into…	把……转变成……

Notes

1. mechatronics: 该单词是一个合成词，即由 mechanical 的前半部分和 electronic 的后半部分组成。中文意思为机械电子学。

2. The concept may seem to be anything but new, since we can look around us and see a myriad of products that utilize both mechanical and electronic disciplines.

我们环顾四周，可以看到，无数利用机械和电子学科的产品，所以（机电一体化）这个概念一点也不新颖。

(1) to be anything but new 不是新事物。

(2) that utilize both mechanical and electronic disciplines 是 products 的定语。

Exercises

What is “Mechatronics”?

Expand Knowledge The Essence of “Mechatronics”

From the very beginnings of recorded time, mechanical systems have found their way into every aspect of our society. Our simplest mechanisms, such as gears, pulleys, springs and wheels, have provided the basis for our tools. Our electronics technology, is completely twentieth-century, all of it created within the past 75 years.

Until now, electronics were included to enhance mechanical systems performance, but the emphasis remained on the mechanical products. There had never been any master plan on how the integration would be done. In the past, it had been done on a case-by-case basis.More recently, however, because of the over-whelming advances in the world of electronics and its capability to physically simplify mechanical configurations, the technical community began to reassess the marriage between these two electronic appendages.

First came the starter motor, and then the generator, each making the original products a better than it was before. Then came solid-state electronics, and suddenly the mechanical marvel became an electro-mechanical marvel.Today’s machine is controlled by microprocessors, built buy robots, and fault-analyzed by a computer connected to its “external interface connector”. Automotive mechanical engineers are no longer the masters of their creations.

The process that describes the evolution of the automobile is somewhat typical of other products in our society. Electronics has repeatedly improved the performance of mechanical systems, but that innovation has been more by serendipity than by design. And that is the essence of mechatronics—the preplanned application of, and the efficient integration of, mechanical and electronics technology to create optimum products.

▶▶▶ Lesson 2　Couplings, Keys, Shafts and Springs

Couplings are used to connect two shafts. For example, a coupling is used to join the shaft of an electric motor to the line shaft of a machine or a hydraulic turbine to an electric generator, or for practical reasons, is used to sectionalize a long shaft, and so on. Couplings used for such typical applications are called permanent couplings because their connections would only be broken for repairs and/or general maintenance. Those applications which require the shafts to periodically disengage are called clutches. Permanent couplings are classified into two groups: flexible couplings and rigid couplings.

Keys are used to prevent relative motion between a shaft and machine elements such as gears, pulleys, sprockets, cams, levers, flywheels, impellers, and so on. There are numerous kinds of keys (some of which have been standardized) for various design requirements. The keys most frequently used are the square key, the tapered key, and the woodruff key.

A shaft is a rotating or stationary member, usually of circular cross section, having mounted upon it such element as gears, pulleys, flywheels, cranks, sprockets, and other power-transmission elements. Shafts may be subjected to bending, tension, compression, or torsional loads, acting singly or in combination with one another. When they are combined, one may expect to find both static and fatigue strength to be important design consideration, since a single shaft may be subjected to static stresses, completely reversed stresses, and repeated stresses, all acting at the same time. The word “shaft” covers numerous variations, such as axles and spindles. An axle is a shaft, either stationary or rotating, not subjected to a torsion load. A short rotating shaft is often called a spindle.

Mechanical springs are used in machines to exert force, to provide flexibility, and to store or to absorb energy. In general, springs may be classified as either wire springs or flat springs, although there are variations within these divisions. Wire springs include helical springs of round, square, or special-section wire and are made to resist tensile, compressive or torsional loads. Under flat springs are included the cantilever and elliptical types, the Clockwork power springs and the flat spring washers, usually called Belleville spring

Words and Phrases

1. coupling [kʌpliŋ]　*n.* 联轴器；连接
2. sectionalize [ˈsekʃənəlaiz]　*vt.* 分段；分布
3. permanent [ˈpəːmənənt]　*a.* 永久的；固定的；恒定的
4. disengage [ˌdisinˈgeidʒ]　*vt.* 脱开，分离；解脱

5. clutch [klʌtʃ]	*n.* 离合器
6. flexible ['fleksəbl]	*a.* 易弯的
7. key [kiː]	*n.* 键；钥匙
8. pulley ['puli]	*n.* 皮带轮
9. sprocket ['sprɔkit]	*n.* 链轮
10. cam [kæm]	*n.* 凸轮
11. lever [liːvə(r)]	*n.* 杠杆
12. flywheel ['flaiwiːl]	*n.* 飞轮
13. impeller [im'pelə]	*n.* 叶轮；转子

Phrases and Expressions

1. rigid coupling	刚性联轴器
2. tapered key	斜键（锥形键）
3. woodruff key	半圆键
4. power-transmission-element	传递动力的零件
5. fatigue strength	疲劳强度
6. cantilever-spring	悬臂式（汽车）弹簧
7. elliptical type spring	椭圆形弹簧
8. Belleville springs	蝶形弹簧（贝氏弹簧）
9. hydraulic turbine	水力透平机

Notes

1. Couplings used for such typical applications are called permanent couplings because their connections would only be broken for repairs and/or general maintenance.

由于这类用途的联轴器其接合状态只是在修理或一般维修时才脱开，故称作固定联轴器。

used for such typical applications 是过去分词短语作后置定语，修饰名词 couplings。

permanent couplings 是主语 couplings 的补足语。

because their connections would only be broken for repairs and/or general maintenance 是原因状语。

2. Shafts may be subjected to bending, tension, compression, or torsional loads, acting singly or in combination with one another.

轴可以承受弯曲、拉伸、压缩或扭转载荷，作用的载荷既可以是单一的，也可以是复合的。

be subjected to …其意为经受、遭受、承受。

acting singly or in combination with one another 为现在分词短语作补充说明，副词 singly 和介词短语 in combination with one another 均作状语，修饰现在分词 acting，意为以单一的形式起作用或以相互结合的形式起作用。

Exercises

1. What are coupling used?
2. What is the function of the key?
3. Give the example of the keys most frequently used?
4. What is the function of mechanical spring?
5. Which several categories can springs be divided into?

Expand Knowledge Stress and Strain

When a load is applied to a material, a balancing force is set up within the material, and this internally acting force is termed a stress. The types of stress normally considered are tensile stress, compressive stress and shear stress. When a material is in a state of stress, its dimensions will be changed. The tensile stress will cause an extension of the length of the material, while the compressive stress will shorten the length. Tensile stress and compressive stress are termed direct stress. The dimensional change caused by stress is termed strain.

In elastic behavior, the strain developed in a material is subjected to a stress, is fully recovered immediately when the stress is removed. Some materials show elastic properties up to quite high levels of stress while others possess little, if any, elasticity. In 1678, Hooke enunciated his law, stating that the strain developed is directly proportional to the stress producing it. This law holds, at least within certain limits, for most materials.

Fig. 2-1 is a Force-extension curve for a metal stressed in tension. The first portion of the curve, *OA*, shows that the length of the specimen increases in direct proportion to the applied load, hence strain will be proportional to stress. Hooke's law does not hold beyond point *A*. Behavior within the region *OA* will be elastic. Beyond point *A* the extension of the material ceases to be wholly elastic and some permanent strain is developed. The elastic permanent strain is termed plastic strain. Point *A* is known as the elastic limit.

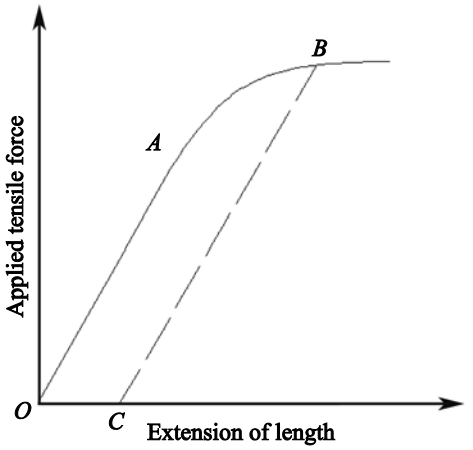


Fig. 2-1 Force-extension curve for a metal

▶▶▶ Lesson 3　Annealing and Normalizing of Plain Carbon Steels

Process Annealing　Cold-worked low-carbon steels (in the form of strip, sheet, wire) are heated, in an insert atmosphere, to 550～600℃, i.e. to below the lower critical temperature, so that the process is also known as “subcritical annealing”.The subsequent cooling rate is not important, but contact of the steel with air should be avoided in order to prevent oxidation. Process annealing is cheaper than full annealing because the latter is carried out at a higher temperature, namely above the upper critical temperature.

Full annealing　Full annealing is the treatment given to produce the softest possible condition in hypoeutectoid steels；the resulting microstructure is completely refined, with accompanying high ductility. It involves heating the steel to about 30℃ above the upper critical temperature and then cooling slowly (e.g.in the furnace).

Full annealing is often used to produce softening and grain refinement in hot-worked hypoeutectoid steels and in steel castings. The soaking time depends on the section thickness (e.g. every 25 mm per hour of workpieces thickness) and the treatment temperature varies with the carbon content as show in Tab. 3-1.

Tab. 3-1　The treatment temperation & the carbon content

Carbon	%	0.1	0.2	0.3	0.5	0.7	0.8
Temperature	℃	900	860	830	810	780	770

Normalizing　Normalizing is carried out on low and medium carbon steels (i.e.material containing less than about 0.6% carbon). The process is applied to achieve the best combination of mechanical properties when it is undesirable for the material to be in the softest possible condition (i.e. fully annealed). The treatment involves heating the steel to about 30℃ above its upper critical temperature (i.e.the same temperature as for full annealing) but followed by cooling in still air. The more rapid cooling (as compared with full annealing) produces a finer pearlite and smaller ferrite grain size, resulting in a slightly harder and stronger material. However, the properties actually obtained in a normalized steel will vary with the section thickness；large normalized sections may show properties similar to those of a fully annealed steel of smaller section.

New words

1. anneal [əˈniːl]　　*vt.* 退火

2. inert [iˈnəːt]	*a.* 惰性的
3. contact [ˈkɔntækt]	*n.* & *v.*（使）接触
4. atmosphere [ˈætməsfiə]	*n.* 大气（压）；气氛；环境
5. critical [ˈkritikəl]	*a.* 决定性的，关键性的，危急的；批判的
6. undesirable [ˈʌndiˈzaiərəbl]	*a.* 不合需要的
7. subsequent [ˈsʌbsikwənt]	*a.* 随后的，后来的
8. microstructure [ˈmaikrəuˈstrʌktʃə]	*n.* 显微结构
9. refine [riˈfain]	*v.* 细化；改善；精练
10. pearlite [ˈpəːlait]	*n.* 珠光体
11. ferrite [ˈferait]	*n.* 铁素体

Phrases and Expressions

1. process annealing	工序间退火
2. subcritical annealing	亚临界退火
3. hype-eutectoid	亚共析（的），亚共析体
4. depend on	依靠

Notes

1. **Process Annealing** Cold-worked low-carbon steels (in the form of strip, sheet, wire) are heated, in an inert atmosphere, to 550～600℃, i.e. to below the lower critical temperature, so that the process annealing is also known as “subcritical annealing”.

工序间退火在惰性气体中，把经过冷成形的低碳钢（带钢、钢板或线材）加热到 550～600℃，也就是临界温度以下，因此工序间退火又叫“在临界温度以下退火”。

Exercises

1. Why is process annealing also known as “subcritical annealing”?
2. Why is process annealing cheaper than full annealing?
3. Describe the process of full annealing.
4. Describe the process of normalizing.

Expand Knowledge　Hardening and Tempering of Plain Carbon Steels

Steels with less than 0.3% carbon can not be effectively hardened, while the maximum hardness is obtained at about 0.8% carbon. Beyond about 0.8% carbon there is an increasing tendency to retain some austenite in the quenched structure, and this austenite offsets any possible increase due to a harder martensite, so that the net hardness remain more or less the same.

Quench hardening　the quench hardening of hypoeutectoid steels involves heating to 30～50℃ above the upper critical temperature, holding at this temperature (about 20 minutes per cm thickness), followed by quenching in water. Hypereutectoid steels, however, are not treated according to the above rules. If a hypereutectoid steel was quenched from above its Ac_3 temperature, then the free cementite present would precipitate at the austenite grain boundaries and thus embrittle the steel. The first step in dealing with these steels is to ensure, by means of hot work (e.g.forging), that the free cementite is dispersed throughout the structure as small particles. The steel is then hardened by heating to about 30℃ above the lower critical temperature, holding and then quenching. This treatment results in a microstructure of spheroidal particles of cementite dispersed in a matrix of martensite.

Tempering　Hardened steels may be tempered by heating them within the temperature range 200～700℃. This treatment will remove internal stress set up during quenching，remove some, or all, of the hardness, and increase the toughness of the material.

Lesson 4 Soldering and Brazing

There are a number of methods of joining metal articles together, depending on the type of metal and the strength of the joint which is required.

Soldering gives a satisfactory joint for light articles of steel, copper or brass, but the strength of soldered joint is rather less than a joint which is brazed, riveted or welded. These methods of joining metal are normally adopted for strong permanent joint. Soldering is the process of joining two metals by a third metal to be applied in the molten state. Solder consists of tin and lead, while bismuth and cadmium are often included to lower the melting point. One of the most important operations in soldering is that of cleaning surfaces to be joined, this may be done by some acid cleaner. Although the oxides are removed by the cleaning operation, a new oxide coating forms immediately after cleaning, thus preventing the solder to unite with the surface of the metal. Flux is used to remove and prevent oxidation of the metal surface to be soldered, allowing the solder to flow freely and unite with the metal. Zinc chloride is the best flux to use for soldering most ferrous and nonferrous metals, and for soldering aluminum, stearine or vaseline is to be used as fluxes.

The soldering copper is a piece of copper attached to a steel rod having a handle. Soldering coppers are made in different lengths, forms and weights. The quality of soldering depends to a great degree on the form and size of the soldering copper. Two parts may be perfectly soldered only when the surfaces to be joined have absorbed enough heat to keep solder melted for some time.

In some cases it may be necessary to connect metal surfaces by means of a hard spelter solder which fuses at high temperature. This kind of soldering is called brazing.

New words

1. solder ['sɔldə] *n.* 焊料
2. spelter ['speltə] *n.* 硬钎焊料；锌铜焊料
3. braze [breiz] *vt.* 铜焊；硬钎焊
4. brazing ['breiziŋ] *n.* 铜焊；硬钎焊
5. join [dʒɔin] *vt.* 连接，结合
6. joint [dʒɔint] *n.* 接缝；接合处
7. bismuth ['bizməθ] *n.* 铋
8. cadmium ['kædmiəm] *n.* 镉
9. flux [flʌks] *n.* 助熔剂，焊剂

10. stearine ['stiəri:n] *n.* 甘油；硬脂
11. vaseline ['væsəli:n] *n.* 凡士林

Phrases and Expressions

1. acid cleaner 酸洗液
2. oxide coating 氧化膜
3. zinc chloride 氯化锌
4. soldering copper 纯铜烙铁
5. spelter solder 硬焊料

Notes

1. One of the most important operations on soldering is that of cleaning the surface to be joint, this may be done by some acid cleaner.

钎焊的最重要工序之一是将需要焊接的焊缝表面清洗干净，这一工序操作可用某种酸洗液进行。

句中的 that 用作代词，代表 operation。

to be joined 是不定式的被动式作定语，修饰名词 the surface。译作“需要焊接的接缝表面”。

2. Two parts may be perfectly soldered only when the surfaces to be jointed have absorbed enough heat to keep solder melted for some time.

只有在焊缝表面吸收足够热量，焊料在一段时间保持熔融状态后，才能将两部分焊牢。

to keep solder melted 是不定式，to keep 带有宾语 solder 以及宾语补语 melted，可译为：使焊料保持熔融状态。

Exercises

Write T if the sentence is true and F if false.

1. Welding produces joining of metals by heating them to suitable temperature, with or without application of pressure or by the application of pressure alone and with or without the use of filler metal. ( )

2. Brazing produces joints stronger than those made by soldering. ( )

3. Soldering is the process of joining two metals by a third metal to be applied on the solid state. ( )

4. Soldering and brazing processes differ from welding in the sense that there is no direct melting of the base metals being jointed. ( )

5. Perhaps, the most important commonly used of all the welding processes is the arc welding. ( )

Expand Knowledge Adhesives

Adhesive bonding of metal parts is a rapidly growing field that influences the design of products of nearly all kinds. The advantages of adhesive are many: No holes (which weaken the part) are required, as with screws and rivets. No temperatures high enough to produce warping and residual stresses are involved, as with welding. When the joint is loaded, stress are spread over a large area, with only minor stress concentration at the edges of contact. This often permits the use of thinner members, resulting in a weight saving. Adhesive bonding permits smooth, unbroken exterior surfaces for good appearance, easier finishing, and reduced fluid friction (in applications involving a flowing liquid or gas, as all airplane wing or helicopter rotor blade). Almost any solid materials, can be bonded with a suitable adhesive. When bonding dissimilar metals, the adhesive layer can provide effective insulation against galvanic currents. Flexibility of the adhesive material can be made to adapt differential thermal expansion of the bonded members. This flexibility also aids in absorbing impact loads. Furthermore, adhesive bonds can provide damping to reduce vibration and sound transmission.

On the negative side, adhesives are more temperature-sensitive than mechanical fasteners. Most adhesives currently in common use are limited to the −129℃ to 260℃. Adhesives vary greatly in temperature response, and this must always be considered when selecting all adhesive for a specific application. Inspection, disassembly, and repair of adhesive joints may not be practical. Also, long-term durability for some adhesives is questionable.

▶▶▶ Lesson 5　Sand Casting

The first stage in the production of sand castings must be the design and manufacture of a suitable pattern. Casting patterns are generally made from hard wood, and the pattern has to be made larger than the finished casting size to allow for the shrinkage that takes place during solidification and cooling.

Sand moulds for the production of castings are made in a moulding box. The mould is made in two or more parts in order that the pattern may be removed. With a two-part mould, the upper half of the moulding box is known as the cope, and the lower half is termed the drag. The drag half of the mould box is placed on a flat firm board and the drag half of the pattern placed in position. Facing sand is sprinkled over the pattern and then the mould box is filled with moulding sand. The sand is rammed firmly around the pattern. When ramming of the sand is complete, excess sand is removed to leave a smooth surface flush with the edges of the moulding box. The completed drag is turned over and the upper, or cope portion of the moulding box is positioned over it. The cope half of the pattern is placed in position, correct alignment being ensured by means of small dowel pins. A thin coating of dry parting sand is sprinkled into the mould at this stage. This is to prevent the cope and drag sticking together when the cope half is moulded. The cope is now filled with moulding sand and this is rammed firmly into shape in the same manner as in the making of the drag. After the ramming of sand in the cope is completed and excess sand has been removed from the top surface, the two halves of the moulding box can be carefully separated. The patterns can be carefully removed from both cope and drag. The mould is reassembled by placing the cope upon the drag and it is then ready for use. Liquid metal can be poured smoothly into the mould via the feeder.

When the metal that has been poured into a sand mould has fully solidified, the mould is broken and the casting can be removed.

New Words

1. casting ['kaːstiŋ]	*n.* 铸件；铸造
2. stage [steidʒ]	*n.* 阶段；步骤
3. pattern ['pætən]	*n.* 模型；样品；图案
4. shrinkage ['ʃriŋkidʒ]	*n.* 收缩；缩水
5. solidification [səlidifi'keiʃn]	*n.* 凝固；固化
6. mould [məuld]	*n.* 模型，铸型，压模
7. cope [kəup]	*n.* 上箱

8. drag [dræg] *n.* 下箱； *v.* 拖，拉
9. sprinkle ['spriŋkl] *n.* & *v.* 洒，喷
10. ram [ræm] *vt.* 锤击；夯紧； *n.* 伸杆；滑枕；夯
11. flush [flʌʃ] *a.* 齐平的； *ad.* 齐平地； *vt.* 使齐平
12. alignment [ə'lainmənt] *n.* 对准；成直线；同轴度
13. dowel ['dauəl] *n.* 定位销，销钉
14. pin [pin] *n.* 销，钉
15. feeder ['fi:də] *n.* 冒口；送料器
16. reassemble [ˌri:ə'sembl] *vt.* 重新组合，重新装配
17. via ['vaiə] *prep.* 经过，经由

Phrases and Expressions

1. be poured into 浇入，注入
2. allow for 考虑到；估计
3. facing sand 面砂
4. moulding box 砂箱
5. parting sand 分型砂

Notes

1. Casting patterns are generally made from hard wood, and the pattern has to be made larger than the finished casting size to allow for the shrinkage that takes place during solidification and cooling.

铸造木模通常由硬质木材制造，考虑铸件在凝固及冷却过程中的收缩，木模的尺寸必须比铸件大一些。

(1) 整个句子是由 and 前后的两个分句组成的并列句。

(2) to allow for … and cooling 是目的状语，修饰第二个分句，其中 that 引导的定语从句修饰 shrinkage.

2. After the ramming of sand in the cope is completed and excess sand has been removed from the top surface, the two halves of the moulding box can be carefully separated.

上箱的砂子夯实以后，除去顶面多余的砂子，然后可以小心地分开上箱和下箱。

(1) 从 after the 到 from the top surface 是状语从句，修饰后面的主句。

(2) 状语从句由两个并列分句组成。

3. When the metal that has been poured into a sand mould has fully solidified, the mould is broken and the casting can be removed.

当浇入砂型的铁水完全凝固之后，便可打破砂型取出铸件。

(1) When the … fully solidified 是状语从句修饰主句。其中，that has … sand mould 是定语从句，修饰 metal。

(2) 后面的主句由 and 连接的两个并列分句组成。

Exercises

1. What is the first stage in the production of sand castings?
2. Why must casting patterns be made larger than the finished casting size?
3. Why is the mould made in two or more parts?
4. Describe the process in the production of a sand mould.

Expand Knowledge Forging

There are two kinds of forging process, impact forging and press forging. In the former, the load is applied by impact, and deformation takes place over very short time. Press forging, involves the gradual build up of pressure to cause the metal to yield. The time of application is relatively long. Over 90% of forging processes are hot.

Impact forging Impact forging can be further subdivided into two main types:

(1) Smith forging Smith forging is undoubtedly the oldest type of forging, but it is now relatively uncommon. The impact force for deformation is applied manually by the blacksmith by means of a hammer. The piece of metal is heated in a forge and when at the proper temperature is placed on an anvil. While being hammered the metal is held with suitable tongs. The easiest metals to forge are the low and medium carbon steels and most smith forgings are made of these metals. The high carbon and alloy steels are more difficult to forge and require great care. Most non-ferrous metals can be successfully forged.

(2) Drop forging Drop forging is the modern equivalent of smith forging where the limited force of the blacksmith has been replaced by the mechanical or steam hammer. The process can be carried out by open forging where the hammer is replaced by a tup and the metal is manipulated manually on an anvil. The quality of the products depends very much on the skill of the forger. Closed-die drop forging is widely used and the tups and anvils are replaced by dies. Fig. 5-1 illustrates the principle of an impact forge.

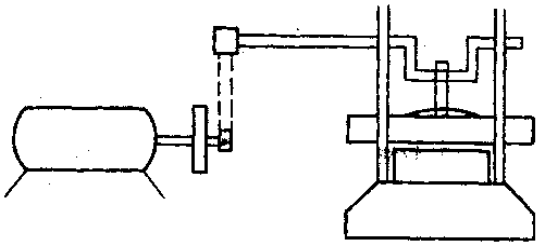


Fig. 5-1 Impact forge

Press forging Whereas impact forging usually involves a mechanical press, press forging, on the other hand, requires hydraulic power. The largest forgings are invariably produced on large hydraulic presses. These have vertically moving rams which move down slowly under considerable pressure. The equipment required is therefore much bigger and Fig. 5-2 shows such a forge. A typical press forge would be capable of loads of the order of 6,000 to 10,000 tones. Forgings up to 100 tons weight can be handled easily in this forge and the highest-quality

products are manufactured by this technique.

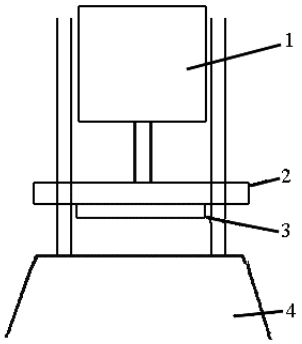


Fig. 5-2 press forge

1-Hydraulic cylinder 2-Crosshead 3-Tup 4-Anvil

Part Ⅱ Speciality

▶▶▶ Lesson 6 Lathe

Machine tools are machines for cutting metals. The most important of machine tools used in industry are lathes, drilling machines, and milling machines. Other kinds of metal working machines are not so widely used in machining metals as these three.

A lathe is a machine tool for cutting metal from the surface of a round work fastened between the two lathe centers and turning around its axis (see Fig. 6-1) . In turning the work, a cutter moves in the direction parallel to the axis of rotation of the work or at an angle to this axis, cutting off the metal from the surface of the work. This movement of the cutter is called the feed. The cutter is clamped in the tool post which is mounted on the carriage. The carriage is the mechanism feeding the cutter in the needed direction. The lathe hand may feed the cutter by hand or may make it be fed automatically by means of special gears.

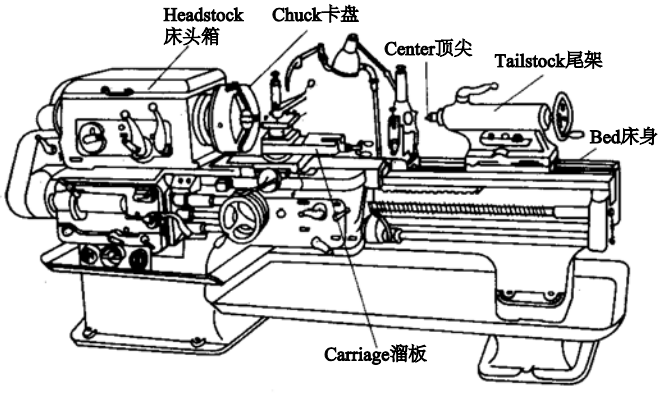


Fig. 6-1 The Lathe

The largest part of the lathe is called the bed on which the headstock and the tailstock are fastened at opposite ends. On the upper part of the bed there are special ways upon which the carriage and tailstock slide.

The two lathe centers are mounted in two spindles, one (the live center) is held in the headstock spindle while the other (the dead center) in the tailstock spindle.

The lathe chuck is used for chucking the work, that is for clamping it so that it will rotate without wobbling while turning. The chuck, usually mounted on the headstock spindle, may have different sizes and construction. If the work is perfectly round, it may be chucked in the so-called three-jaw universal chuck all the jaws of which are moved to the center by turning the screw. But if the work is not perfectly round, the four-jaw independent chuck should be used.

In turning different materials and works of different diameter, lathes must be run at different speeds. The gear-box contained in the headstock makes it possible to run the lathe at various speeds.

Before turning a work in the lathe, the lathe centers are to be aligned. That means that the axes of both centers must be on one line.

The alignment of the lathe centers may be tested by taking a cut and then measuring both ends of the cut with a micrometer.

Not all works should be fastened between the two centers of the lathe. A short work may be turned without using the dead center, by simply chucking it properly at the spindle in the headstock.

New Words

1. lathe [leið] *n.* 车床
2. drill [dril] *n.* 钻头；*vt.* 钻（孔）
3. drilling ['driliŋ] *n.* 钻削
4. mill [mil] *n.* 铣刀，铣床，铣
5. milling ['miliŋ] *n.* 铣削
6. fasten ['fɑːsən] *vi.* 固定，紧固
7. turn [təːn] *vt.* 旋转；车削
8. axis ['æksis] axes ['æksiːz]（axis 的复数） *n.* 轴线，轴心
9. cutter [kʌtə(r)] *n.* （切削）刀具
10. feed [fiːd] *vt.* & *n.* 进给，送给
11. clamp ['klæmp] *vt.* 夹紧； *n.* 夹具体
12. carriage ['kæridʒ] *n.* 溜板；拖板
13. bed [bed] *n.* 床；床身
14. headstock ['hedstɔk] *n.* 头架；车床头；主轴箱；床头箱
15. tailstock ['teilstɔk] *n.* 尾架；尾座
16. slide [slaid] *v.* 滑动；*n.* 滑板，滑块
17. metalwork ['metlwəːk] *n.* 金属加工（制造）

18. spindle ['spindl] *n.* 心轴，主轴
19. chuck [tʃʌk] *n.* 卡盘；用（卡盘）夹紧
20. wobble ['wɔbl] *vi.* 摇晃，摇摆
21. jaw [dʒɔ:] *n.* 卡爪；虎钳牙
22. align [a'lain] *vt.* 使成一直线；校正
23. micrometer [mai'krɔmitə] *n.* 测微器；千分尺

Phrases and Expressions

1. machine tool 机床
2. milling machine 铣床
3. tool post 刀座，刀架
4. cut off 切掉，切断；关掉
5. live center 活顶尖
6. dead center 死顶尖
7. three-jaw universal chuck 三爪万能卡盘
8. four-jaw independent chuck 四爪独立卡盘

Notes

1. Other kinds of metal working machine are not so widely used in machining metals as these three.

其他类型的金属切削机床在金属切削加工方面不如这三种机床使用广泛。

not so…as…与……不一样

as these three 为省略形式的比较状语从句。

作原级形容词表示比较，通常有下述三种结构：

(1) as+原级形容词+as：像……一样

(2) not so+原级形容词+as：不如……那样

(3) not as+原级形容词+as：不像……那样

例如：Line *AB* is as long as line *CD* (is).

Line *AB* is not so long as line *CD*.

Line *AB* is not as long as line *CD*.

2. A lathe is a machine tool for cutting metal from the surface of a round work fastened between the two lathe centers and turning around its axis.

车床是用来从车床两个顶尖之间紧固的圆形工件表面切割金属的机床，工件绕车床顶尖轴线旋转。

fastened between the two lathe centers 和 turning around its axis 是两个并列的分词短语，fastened 含有被动的意义，turning 含有主动的意义，均作定语修饰名词 work。its 是指 round work。

3. In turning the work, a cutter moves in the direction parallel to the axis of rotation of the work or at an angle to this axis, cutting off the metal from the surface of the work.

车床车削工件时，车刀沿着工件的旋转轴线平行移动或者与工件的旋转轴线交一斜角移动，将工件表面的金属切除。

句中 parallel to the axis of rotation of work 做后置定语，修饰名词 direction；cutting off the metal from the surface of the work 为分词短语作状语，表示伴随情况。这种状语往往放在句末，常用逗号与句子的其他成分隔开。

4. The lathe hand may feed the cutter by hand or may make it be fed automatically by means of special gears.

车工可用手来实现手动进刀，也可借助专门的齿轮组实现自动进刀。

有些动词如 make，hear，see，watch 后的不定式作宾语补足语时，可不带不定式符号 to；be fed 是不定式的被动式，作宾语 it 的补语；the lathe hand 为主语，带有两个并列的谓语 may feed 和 may make。

5. The gear-box contained in the headstock makes it possible to run the lathe at various speeds.

装入床头箱内的齿轮箱能使车床以不同的速度运转。

it 在句中作形式宾语，而真正的宾语是不定式短语 to run the lathe at various speeds，它通常放在宾语补足语（possible）的后面；contained in the headstock 作后置定语，修饰名词 the gear box。

6. Before turning a work in the lathe, the lathe centers are to be aligned. That means that the axes of both centers must be on one line.

车床在车削工件前，它的顶尖要对准，即两个顶尖的轴线必须在一条直线上。

句中有两个 that，前一个 that 用作指示代词，代表前面句子的内容，即代表 the lathe centers are to be aligned；后一个 that 用作连接词，无词义，引出宾语从句 that the axes of both centers must be on one line。to be aligned 是不定式的被动式，在句中作表语。

Exercise

Ⅰ. Make T if the sentence is true and F if false.

1. Lathe is a machine tool for holding and turning metal, plastic or other material against a cutting tool to form a cylindrical product. (　　)

2. If the work is not perfectly round, it may be chucked in the so-called three-jaw universal chuck. (　　)

3. The lathe is one of the most important machines in a machine shop. (　　)

4. The headstock which holds the other end of the work, moves along the bed, and can be damped in position at any point. (　　)

5. The most important of machine tools used on industry are lathes, drilling machines, and milling machines. (　　)

6. The smallest part of the lathe is called the bed on which the headstock and the tailstock are fastened at opposite ends. (　　)

Ⅱ. Fill the blanks with the words and expressions given below.

Springs and pulleys; gears and pulleys; right; feeding; carrying; three-jaw; four-jaw; left; short; measurement; alignment; long.

1. The headstock is mounted at the_____end of the lathe.

2. It contains the headstock spindle, which is rotated by a combination of _____.

3. But if the work is not perfectly round, the_____independent chuck should be used.

4. The carriage is the mechanism_____ cutter in the needed direction.

5. The_____of the lathe centers may be tested by taking a cut and then measuring both ends of the cut with a micrometer.

6. A_____work may be turned without using the dead center, by simply chucking it properly at the spindle of the headstock.

Ⅲ. Answer the following questions.

1. What is a machine tool?

2. Which machine tool is most widely used in metal working industry?

3. How many work center are there on a lather?

4. Where is the dead center mounted?

5. What is a chuck?

Expand Knowledge　Cutting Tools

Metal cutting tools must possess a variety of different properties in order to cut the different metals under varying conditions of severity. To meet these demands, tools have been produced from a variety of materials.

The most important properties of cutting tools are hardness at high temperature, wear resistance, and impact strength.

As a tool cuts, high heat is developed as a result of compression and friction at the cutting edge of the tool. All metal cutting tools begin to lose hardness when heated to sufficiently high temperatures. As the tool softens due to heat, it wears and breaks down at the cutting edge or face. Various cutting tool materials begin to lose their hardness at different temperatures. Hence, the hardness of the tool and the degree to which it remains its hardness at high temperature are important in the selection of a cutting tool material.

A cutting tool is wear-resistant if it resists abrasion at the cutting edge and along the tool face. Wear resistance improves as cutting tool hardness increases.

Cutting tools must also have high strength in order to be vibration-resistant and impact-resistant. Strength in cutting tool material is not always proportional to hardness. Some of the hardest tool materials lack strength because they are too brittle.

The various materials from which most metal cutting tools are made can be classified under the following principals：

1. Carbon tool steel
2. High speed steel
3. Cast alloys
4. Cemented carbides
5. Ceramics
6. Diamonds

Tool life or the number of pairs produced by a cutting-tool edge before regrinding is required, is a very important cost factor in manufacturing a part or product. Cutting tools must be reground at the first sign of dullness. If a tool is used beyond this point, it will break down rapidly.

In order to detect the time when a cutting tool should be changed, most modern machines are equipped with indicators that show the horsepower used during the machining operation. When a tool becomes dull, more Watt is required for the operation, which will show on the indicator. When this occurs, the tool should be reconditioned immediately.

Lesson 7 Hydraulic Systems of Machine Tools

Hydraulic systems are now ever more widely used in machine tools as principal and feed movement drives, speed-changing devices, braking mechanisms, clamping devices, automatic control of machining cycle, etc. Hydraulic systems become the main type of drive in machine tools like grinders, shapers, copying millers, broaching machines, etc.

This extensive use of hydraulic systems is due to their capability of providing infinitely variable speed over a wide range, smooth reversal of moving machine members, automatic overload protection, easy lubrication, etc. Hydraulically controlled machine tools take less floor space, and their parts and units can be easily standardized. Among their shortcomings are leakage of hydraulic fluid through seals and gaps, ingress of air into fluid, effects of temperature and time on fluid properties, etc.

Energy losses in hydraulic systems are made up of volumetric losses due to leakage of hydraulic fluid, hydraulic losses due to a drop in pressure, and mechanical losses due to friction of contact surfaces.

Total efficiency of the hydraulic system:

$$\eta=\eta_v\eta_h\eta_m$$

where η_v, η_h, η_m is volumetric efficiency, hydraulic efficiency and mechanical efficiency, respectively.

Normal functioning of the hydraulic system largely depends on the type of working fluid employed. This fluid should be sufficiently viscous and uniform; it should possess good lubricity and protect mechanisms from corrosion; it should retain its properties with changes in temperature, pressure, speed and direction of movement. The working fluid should not become oxidized or evolve sediments, evaporate or inflame. These requirements are best met by mineral oils and their mixtures.

The principal property used in selecting and comparing oils is the viscosity index, which shows the change in the viscosity of an oil with its temperature. The higher the viscosity index, the higher the quality of the oil and the higher its refinement. Oil viscosity index 90 is best suited for hydraulic systems.

Typically, the machine-tool hydraulic system includes：an oil tank; a pump to deliver oil into the system; control devices (valves, pressure relays, timers, etc.) to control pressure and volume of oil in the system; distributing devices to control the working cycle; operative cylinders for straight movement and hydraulic motors for rotating movement; piping to connect all the elements of the system.

New words

1. shaper ['ʃeipə]	*n.* 牛头刨床
2. extensive [iks'tensiv]	*a.* 广泛的，广大的
3. standardized ['stændə,daizd]	*a.* 标准化的
4. leakage ['li:kidʒ]	*n.* 泄漏
5. seal [si:l]	*n.* 密封垫
6. ingress ['ingres]	*n.* 进入
7. efficient [i'fiʃənt]	*n.* 效率；功效
8. volumetric [vəlju'metrik]	*a.*（测）容量的
9. viscous ['viskəs]	*a.* 黏性的
10. lubricity [1ju:'brisiti]	*n.* 润滑性能
11. evolve ['ivɔlv]	*vt.*（使）逐渐形成
12. sediment ['sedimənt]	*n.* 沉淀（物）
13. retain [ri'tein]	*vt.* 保持，保留
14. evaporate [i'væpəreit]	*v.*（使）蒸发
15. inflame [in'fleim]	*v.*（使）燃烧
16. viscosity [vi'skɔsəti]	*n.* 黏性
17. valve [vælv]	*n.* 阀
18. typically ['tipikəli]	*ad.* 典型地，具有代表性地
19. cylinder ['silində]	*n.* 液压缸
20. piping ['paipiŋ]	*n.* 管道

Phrases and Expressions

1. broaching machine	拉床
2. copying miller	仿形铣床
3. viscosity index	黏度指数
4. pressure relay	压力继电器

Notes

1. Hydraulic systems are now ever more widely used in machine tools as principal and feed movement drives, speed-changing devices, braking mechanisms, clamping devices, automatic control of machining cycle, etc.

现在，液压系统在机床中得到了更广泛的应用。主要用于主运动和进给运动的驱动，控制变速机构、刹车机构和夹紧机构及工作循环的自动控制等。

2. Energy losses, in hydraulic systems are made up of volumetric losses due to leakage of hydraulic fluid, hydraulic losses due to a drop in pressure, and mechanical losses due to friction of contact surfaces.

液压系统的能量损耗包括由于液压液体泄漏造成的流量损耗、由于压力下降造成的压

力损耗及由于接触表面的摩擦造成的机械损耗。

Exercises

1. Why are hydraulic systems extensively used in machine tools?
2. What are the shortcomings of hydraulic systems?
3. What properties should working fluid have?
4. What is the principal property used in selecting and comparing oils?
5. What does the machine tool hydraulic systems include?

Expand Knowledge　Pressure and Flow Control

Hydraulic energy is produced as long as the prime mover (usually an electric motor) drives the pump, and hydraulic pressure develops by resistance to pump flow. Hence, the hydraulic system suffers damage if the pump flow is not stopped or off-loaded (re-circulated) back to tank during non-action periods of the circuit. Non-action periods arise from stalling all actuator, or by reaching the end of the stroke or the circuit sequence, or during the time-delay periods of the circuit sequence.

In order to avoid hydraulic system damage, power wastage, and overheating of the hydraulic fluid, circuit designers use a variety of cleverly designed systems to control maximum system pressure and pump flow during non-action periods.

Pressure control valves are used in hydraulic systems to control actuator force (force = pressure × area), and to determine and (pre) select pressure levels at which certain machine operations must occur. Pressure controls are in the main used to perform the following system functions:

(1) To limit maximum system pressure in a hydraulic circuit or sub-circuit, and thus provide overload protection.

(2) To provide re-direction of pump flow to tank, while system pressure must be maintained (system unloading).

(3) To provide re-direction of pump flow to tank while system pressure is not maintained (system off-loading).

(4) To offer resistance to fluid flow at selectable pressure levels(counterbalance force).

(5) To provide an alternative flow path for the fluid at selected pressure levels(pressure sequencing).

(6) To reduce (or step down) pressure levels form the main circuit to a lower pressure in a subcircuit.

Pressure control valves are often difficult to identify, mainly because of the many descriptive names applied to them. The function of the valve in the circuit usually becomes the basis for its name. The valves used to accomplish the above mentioned system functions are therefore given the following names, respectively：

(1) Relief valve

(2) Unloading relief valve

(3) Offloading valve

(4) Counterbalance valve and brake valve

(5) Pressure-sequence valve

(6) Pressure-reducing valve

Flow-control valves are used in hydraulic systems to control the rate of flow from one part of the system to another. Flow-control devices accomplish one or more of the following control functions:

• Limit the maximum speed of linear actuators and hydraulic motors (flow rate / piston area = piston speed).

• It obtains the maximum power available to the subcircuit by controlling the flow to them (power = flow rate × pressure).

• Proportionally divide or regulate the pump flow to various branches of the circuit.

A partly closed orifice or flow control valve in a hydraulic pressure line causes resistance to pump flow. This resistance raises the pressure upstream of the orifice to the level of the relief valve setting and any excess pump flow must pass via the relief valve to the tank (Fig. 7-1).

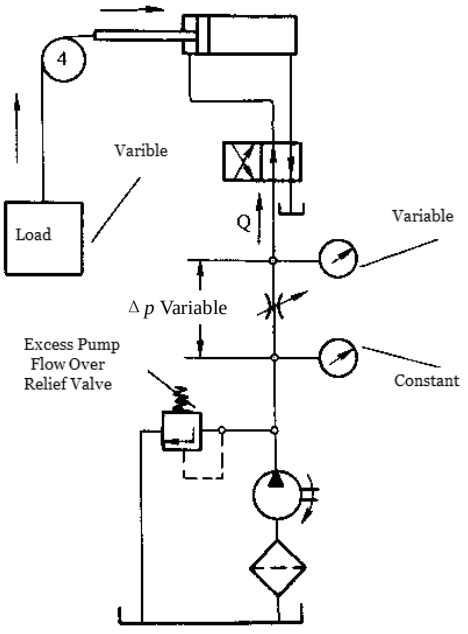


Fig. 7-1 Simple restrictor type flow control valve

In order to understand the function and operation of flow-control devices, one must comprehend the various factors that determine the flowrate (Q) across an orifice or restrictor. These factors are:

• Cross-sectional area of the orifice (mm^2);

• Shape of the orifice (round, square, triangular);

• Length of the restriction;

• Pressure differential across the orifice (ΔP);

• Viscosity of the fluid (depending on the temperature).

Thus, the law that given the flow rate across a given orifice can by approximation be defined as $Q_2 \propto \Delta P$. This implies that any variation in pressure up, or downstream of the orifice changes the pressure differential ΔP, and thus changes the flow rate through the orifice. The pressure upstream of the flow-control valve is normally kept constant by either the system relief valve or by the pressure controller on a variable displacement pump. Variations in the pressure differential (ΔP) are thus only caused by pressure fluctuations down stream, as a result of varying load forces on the actuator.

Lesson 8 Types of Control Devices

Several types of control devices are used in industry to satisfy the following control needs：

- Mechanical Control
- Pneumatic Control
- Electromechanical Control
- Electronic Control
- Computer Control
- Programmable Logic Control (PLC)

Mechanical control includes cams and governors. Although they have been used for the control of very complex machines, to be cost effectively, today they are used for simple and fixed-cycle task control. Some automated machines, such as screw machines, still use cam-based control. Mechanical control is difficult to manufacture and is subject to wear.

Pneumatic control is still very popular for certain applications. It uses compressed air, valves, and switches to construct simple control logic, but is relatively slow. Because standard components are used to construct the logic, it is easier to build than a mechanical control. Pneumatic control parts are subject to wear.

As does a mechanical control, an electromechanical control uses switches, relays, timers, counters, and so on, to construct logic. Because electric current is used, it is faster and more flexible. The controllers using electromechanical control are called relay devices.

Electric control is similar to electromechanical control, except that the moving mechanical components in an electromechanical control device are replaced by electronic switches, which works faster and more reliable.

Computer control is the most versatile control system. The logic of the control is programmed into the computer memory using software. It not only can be for machine and manufacturing system control, but also for data communication. Very complex control strategies with extensive computations can be programmed. The first is the interface with the outside world. Internally, the computer uses a low voltage (5V to 12V) and a low current (several milliamp). Machine requires much higher voltage (24V, 110V, or 220V) and currents (measured in amp). The interface not only has to convert the voltage difference, but also must filter out the electric noise usually found in the shop. The interface thus must be custom-built for each application.

New Words

1. pneumatic [nju: 'mætik]	*a.* 气动的，空气的
2. governor ['gʌvənə(r)]	*n.* 操纵杆，控制器
3. relay ['ri:lei]	*n.* 继电器
4. timer ['taimə(r)]	*n.* 定时器；计时员
5. counter ['kauntə(r)]	*n.* 计数器
6. construct [kən'strʌkt]	*vt.* 修建，建立；构成，组成
7. computation [ˌkɔmpju'teiʃən]	*n.* 计算；估计；计算法；测定
8. milliamp (mA) [mili'æmp]	*n.* 毫安
9. convert [kən'və:t]	*vt.* & *vi.* （使）转变，（使）转化
10. interface ['intəfeis]	*n.* [计]接口
11. voltage ['vəultidʒ]	*n.* 电压，伏特数
12. memory ['meməri]	*n.* 存储；存储器；记忆装置
13. strategy ['strætidʒi]	*n.* 战略，策略

Phrases and Expression

1. pneumatic control	气动控制
2. electromechanical	机电的
3. screw machine	车丝机，制螺纹机
4. filter out	过滤
5. custom-built	客户定制

Notes

1. Although they have been used for the control of very complex machines, to be cost effective, today they are used for simple and fixed-cycle task control.

尽管它们过去只被用在对复杂机器进行控制的场合，但现在它们已应用于控制简单而固定循环的场合。

They 代替“cams and governors”.

2. Because standard components are used to construct the logic, it is easier to build than a mechanical control.

It is easier to do sth. … than … 更容易做……事情。

由于可用标准件构成各种逻辑，因此气动控制的加工制造比机械控制更容易。

3. As does a mechanical control, an electromechanical control uses switches, relays, timers, counters, and so on, to construct logic.

正像机械控制那样，机电控制使用开关、延时器、计数器和计时器等其他元器件构成各种逻辑指令。

“as does a mechanical control”由 as 引导的比较状语从句。

4. Electric control is similar to electromechanical control, except that the moving

mechanical components in an electromechanical control device are replaced by electronic switches, which works faster and more reliable.

电气控制类似于机电控制，所不同的是机电控制机构中的可动零部件被动作更快、可靠性更高的电气开关所代替。“except that … +从句”是介词短语引导的从句，为前面主句的状语。

5. The interface thus must be custom-built for each application.

因此须根据应用场合的不同构造用户接口。“custom”原意为“习惯、惯例”，在此引申为“用户”。

Exercises

Ⅰ. Answer the following questions briefly.

1. How many types of control can be divided into and give the details?

2. How does the computer control work?

3. What does an electromechanical control use to construct logic?

Ⅱ. Translate the following sentences into Chinese.

1. Although they have been used for the control of very complex machines, to be cost effective, today they are used for simple and fixed-cycle task control.

2. Electric control is similar to electromechanical control, except that the moving mechanical components in an electromechanical-control device are replaced by electronic switches, which works faster and more reliable.

3. The interface thus must be custom-built for each application.

Expand Knowledge　PLC

In order to use the advantages of all those controllers and eliminate the difficulties, the programmable logic controllers were invented. A PLC is a replacement for relay devices. They are programmed using a ladder diagram, which is standard electric wiring diagram. As PLC become more flexible, high-level as well as low-level languages are available to PLC programmers. PLC have the flexibility of computers as well as a standard and easy interface with processes and other devices. They are widely accepted in industry for controlling from a single device to a complex manufacturing facility.

Programmable logic controllers (PLC) were first introduced in 1968 as a substitute for hardwired relay panels. The original intent was to replace a mechanical switching device (relay modules). However, since 1968, the capabilities of the PLC were to replace relay panels, modern PLC have many more functions. Their use extends from simple process control to manufacturing system controls and monitoring.

They are used for high-speed digital processing, high-speed digital communication, high-level compute-language support, and, of course, for basic process control (Fig. 8-1).

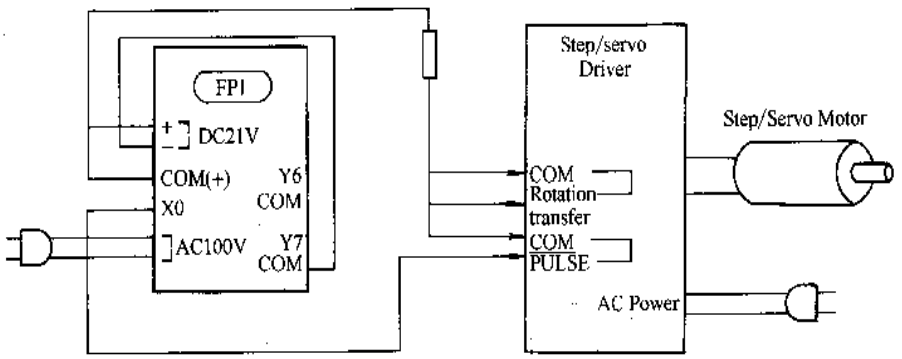


Fig. 8-1　Application of PLC (Control Step / Servo Motor)

PLC vary in size and power. A large PLC can have up to 10,000 I/O points and support all the functions discussed earlier. There are also expansion slots to accommodate PC and other communication devices. For many applications, a small PLC is sufficient. Fig. 8-2 shows a small PLC. It has 16 I/O points and a standard RS-232 serial communication port. The speed of PLC are constantly improving, even the low-end PLC perform at high speed. 1～2μm / kB of memory speed is very common.

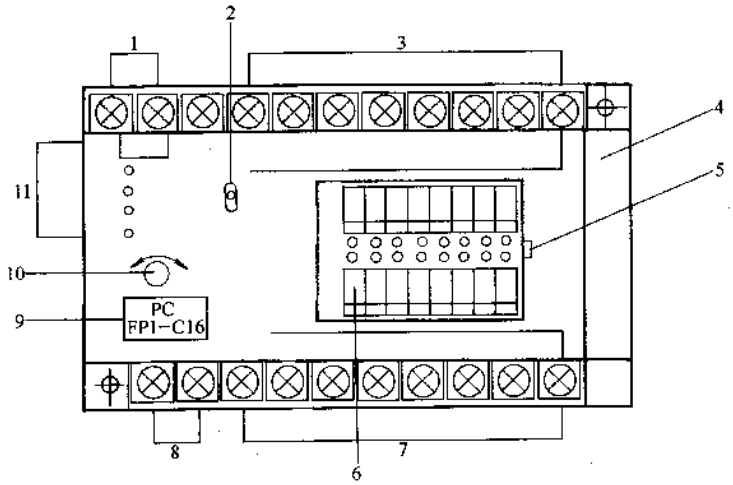


Fig. 8-2 A small PLC（FPl-C16 Control Panel）

1-AC/DC Power Input 2-Mode Select 3--output 4-I/O Expansion Slot
5-I/O Status LED 6-Label 7-Input 8-DC Power Output
9-Programmer Interface 10-Adjustable Input 11-PLC Status LED

▶▶▶ Lesson 9　Numerical Control Programme

Part Programming

A part programmer is a very crucial person in any NC manufacturing system. On obtaining the component drawing, he decides the sequence of operations, the speeds and feed for the various operations and determines the magnitude of various motions desired. Therefore, it is important that he should be familiar with the various operations and machine tools to be used. He should be able to carry out calculations based on geometry and trigonometry.

Data Required for Programming

To prepare the manuscript for manual part programming, the programmer needs to collect some data pertaining to the work to be carried out. This data would be as follows：

(1) Machine tools specifications.

(2) Specification of all tools.

(3) Specification of work material.

(4) Speed feed tables.

EIA / ISO Code

For coding on the tape, EIA or ISO codes should be followed. NC machines are generally equipped to handle both types of information. Nowadays mostly ISO codes are used.

In a program this entire information is called block. There are 3 types of formats for representing the block in punched tape:

(1) Fixed sequential format.

(2) Word address format.

(3) Tab sequential format.

The following are the letter addresses used in programming：

N　operation sequence number address.

G　preparatory function address.

X, Y, Z, A, B, C … dimension address.

S　spindle speed address.

F　feed rate address.

T　tool address.

M　miscellaneous function address.

Preparatory Function

This information is given by a word which is prefixed by the letter G followed by the numerical code for the operation, for which the control unit is to instruct the machine tool. For example, G81 means that the instruction is to drill. The other parameters necessary for carrying

out the operation would follow. The G … will not be able to operate the machine tool until all the relevant information, which follows is processed.

Absolute and incremental preparatory function

Preparatory function G90 and G91 are used for specifying that the data in the following block is in absolute mode (relative to a common datum) or incremental mode (relative to current position) respectively. G90 can be cancelled by G91; or vice versa.

Miscellaneous Function

For carrying out some operation, it may be desirable to start the spindle and have its rotation clockwise or anticlockwise. Words used for such instruction are termed as miscellaneous functions. Similarly, starting or stopping the coolant also fall under this category. These instructions are not pertaining to dimensions of the work but are required for carrying out the operation. The machine tools responds information is prefixed by the alphabet M followed by the numerical code for the function required. For example, M03 would mean spindle to rotate clockwise, while $M0_4$ anticlockwise.

New words

1. crucial ['kru:ʃəl] *a.* 决定性的；紧要关头的
2. component [kəm'pəunənt] *n.* 成分，组成部分；部件，元件
3. magnitude ['mægnitju:d] *n.* 大小，积，量，长（度）；巨大；重要性
4. geometry [dʒi'ɔmitri] *n.* [数] 几何（学）
5. trigonometry [trigə'nɔmitri] *n.* 三角（学）
6. convey [kən'vei] *vt.* 运输，运送；表达，转达
7. sequential [si'kwenʃl] *a.* 按次序的；相继的；连续的
8. anticlockwise ['ænti,klɔkwaiz] *a.* 逆时针的
9. prefix ['pri:fiks] *n.* [语] 前缀

Phrases and Expression

1. the sequence of operations 工序
2. are distinguished by 区别于

Notes

1. Therefore, it is important that he should be familiar with the various operations and machine tools to be used.

因此，他（编程员）应熟悉各种加工和所用机床，这一点很重要。

It is+adj. +that clause …，主语从句。

2. To prepare the manuscript for manual part programming, the programmer needs to collect some data pertaining to the work to be carried out.

为了给零件手工编程准备好草稿，编程员需要收集与零件加工相关的资料。

to prepare … 引导目的状语；carry out 意为执行，施行。

Exercises

Ⅰ. Translate the following expressions into Chinese.

1. part programmer
2. component drawing
3. geometry and trigonometry
4. preparatory function
5. miscellaneous function
6. incremental mode
7. clockwise direction and anticlockwise direction

Ⅱ. There are a few preparatory and miscellaneous functions, translate and recite them.

G00 positioning
G01 linear interpolation
G02 clockwise circular interpolation (CW)
G03 anticlockwise circular interpolation (CCW)
G90 absolute data
M00 program stop
M02 end of program

Ⅲ. Translate the following passage into Chinese.

A numerical control machine is a machine positioned automatically along a preprogrammed path by means of coded instructions. So, some one has to determine what operations the machine is to perform and put that the information into a coded form that the NC control unit understands before the machine can do anything. Machine may be programmed manually or with the aid of a computer. Manually programming is called manual part programming, and programming done by a computer is called computer aided programming (CAP).

Expand Knowledge Coordinate System for NC Machines

In an NC system, each axis of motion is equipped with a separate driving source that replaces the hand wheel of the conventional machine. The driving source can be a DC motor, a stepping motor, or a hydraulic actuator. The source selected is determined mainly based of the precision requirements of the machine.

The relative movement between tools and workpieces is achieved by the motion of the machine tool slides. The three main axes of motion are referred to as the *x*, *y*, and *z* axes. The *z* axis is perpendicular to both the *x* and *y* axes in order to create a right-hand coordinate system, as shown in Fig. 9-1. A positive motion in the *z* direction moves the cutting tool away from the workpiece.

It is detailed as follows:

1. *z* AXIS

(1) On a workpiece-rotating machine, such as a lathe, the *z* axis is parallel to the spindle, and the positive motion moves the tool away from the workpiece (Fig. 9-1).

(2) On a tool-rotating machine, such as a milling or a boring machine, the *z* axis is perpendicular to the tool set, and the positive motion moves the tool away from the workpiece (Fig. 9-2 and Fig. 9-3).

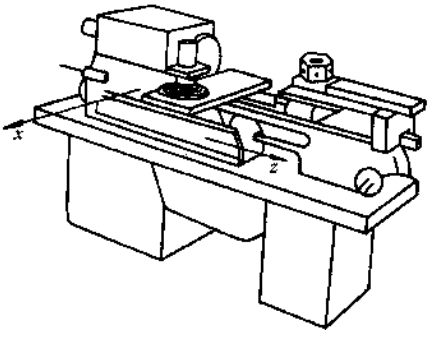


Fig. 9-1 Coordinate system for a lathe

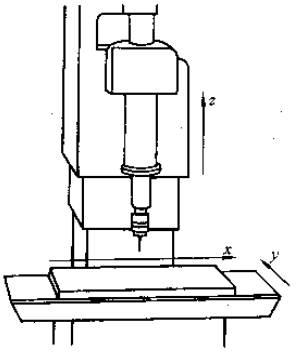


Fig. 9-2 Coordinate system for a drill

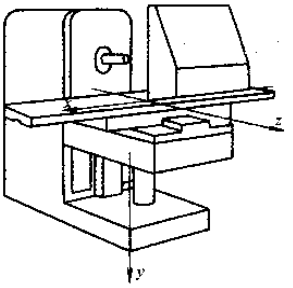


Fig. 9-3 Coordinate system for a mill

(3) On other machines, such as a press, a planing machine, or shearing machine, the z axis is perpendicular to the tool set, and the positive motion increases the distance between the tool and the workpiece.

2. *x* AXIS

(1) On a lathe, the *x* axis is the direction of tool movement, and positive motion moves the tool away from the workpiece.

(2) On a horizontal milling machine, the *x* axis is parallel to the table.

(3) On a vertical milling machine, the positive *x* axis points to the right when the programmer is facing the machine.

3. *y* AXIS

The *y* axis is the axis left in a standard Cartesian Coordinate system.

Lesson 10 Jig Types

The term jig refers to any device used to ensure that holes are drilled, reamed, or tapped in the proper location.

Four common jig types will be covered below.

Box Jigs A box jig is a special fabricated jig that assumes the basic shape of a box (see Fig. 10-1). The base of the box is normally used to locate and clamp the workpiece while supporting the sides of the jig. The sides of the box may also be used to aid in the clamping or locating of the workpiece while providing support for the bushing plate. The top of the box carries one or more bushings that are precisely positioned with respect to the location plane and points. This jig type is rigid and very accurate, making it a popular style for many applications. However, the fixed bushing plate slows the loading and unloading time invested in each production part. Chip removal from the interior of the box may also be difficult, periodically delaying the operation.

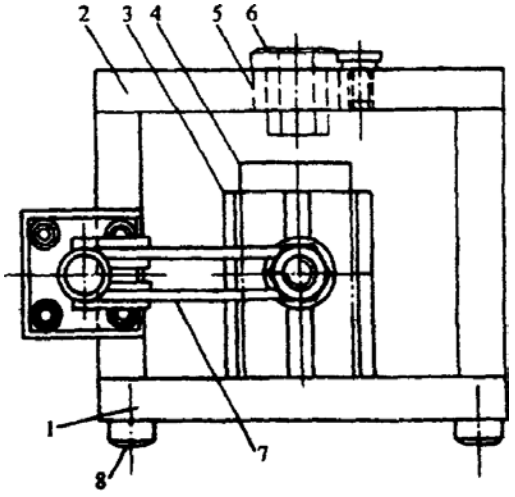


Fig. 10-1 Box Jig

1-Base plate 2-Bushing plate 3-Vee block locator 4-Workpiece
5-Liner bushing 6-Fixed renewable bushing 7-Toggle clamp 8-Jig feet

Tumble Jigs When a given workpiece requires the drilling of holes on more than one face, a tumble jig may be considered. A tumble jig is a variation of the box jig in which drill bushing are found in one or more sides of the jig. In low-volume applications, the workpiece is positioned inside the tumble jig and clamped. Then, by flipping the jig from one side to another,

each drill bushing incorporated in the jig is exposed to the drill spindle. The major advantages of the tumble jig are: (1) reduced hole-to-hole spacing errors due to one location and clamping;

(2) one jig takes the place of many;

(3) operation times are reduced with less handling.

Indexing Jigs: Indexing jigs, with either horizontal or vertical mounts, are commercially available standards designed to accommodate the drilling of circular hole patterns (see Fig. 10-2). The workpiece is located and clamped under a single bushing. The position of the bushing is adjustable for height and location over the workpiece. This adjustment permits using a single jig for a wide variety of similar parts. Holes may be located from the first hole drilled by using the indexing head. Head may be equipped with special indexing plates that allow for special or odd angle indexing.

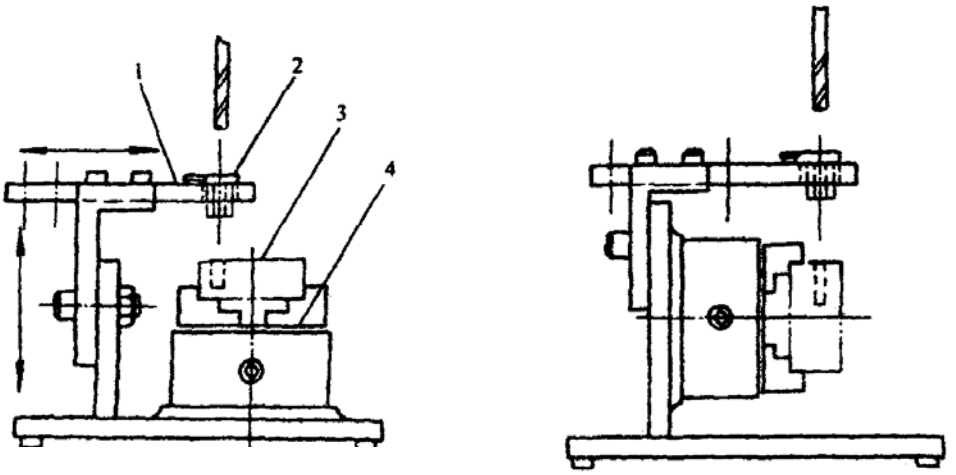


Fig. 10-2 Indexing Jigs

(a) Horizontal mount (b) Vertical mount

1-Bushing tray; 2-Bushing; 3-Workpiece; 4-Indexing head

Plate Jigs The plate jig is distinguished by its main structural member, which is a plate. All other jig details are attached to this plate. The open construction of this jig type facilitates the loading and unloading of irregularly shaped workpieces.

New Words

1. jig [dʒig]	*n.* 夹具；钻模
2. variation [ˌveəriˈeiʃən]	*n.* 变化；变动
3. indexing [ˈindeksiŋ]	*n.* 分度；指标
4. fabricate [ˈfæbrikeit]	*vt.* 制作；装配；组合
5. locating [ləuˈkeitiŋ]	*n.* 定位（法）
6. assume [əˈsju:m]	*vt.* 呈（某形式）；假定；承担；接受

7. bushing ['buʃiŋ]	*n.* 钻套，衬套
8. interior [in'tiəriə]	*n.* & *a.* 内部（的）
9. tumble ['tʌmbl]	*n.* 翻滚
10. flip [flip]	*vt.* 使翻转；掷
11. incorporate [in'kɔ:pəreit]	*vt.* 结合；使混合
12. accommodate [ə'kɔmədeit]	*v.*（使）适应

Phrases and Expressions

1. invest in	投入
2. be exposed to	招致，遭受；曝露于
3. box jig	箱式钻模，固定式钻模
4. tumble jig	翻转式钻模，滚筒夹具
5. indexing jig	回转式钻模
6. plate jig	盖板式钻模，平板式钻模

Notes

1. The base of the box is normally used to locate and clamp the workpiece while supporting the sides of the jig.

夹具的底座（夹具体）用于支承夹具的侧壁，通常也用于定位并夹紧工件。

2. The top of the box carries one or more bushings that are precisely positioned with respect to the location plane and points.

夹具的顶面装有一个或几个相对定位面（或点）精确定位的钻套。

Exercises

1. List two main hole-making processes.
2. Give definition of the term jig.
3. List four types of jig.
4. State the advantages and disadvantages of box jig.
5. What are the major advantages of the tumble jig?

Expand Knowledge　Bushing Types and Applications

Headless Press Fit Bushing　The headless press fit bushing is specified in many low production jigs. The bushing is pressed into the bushing plate until it is flush with the top of the plate. The lack of a head minimizes clearance problems and allows two or more bushing to be placed on close centers.

Head Press Fit Bushings　The head press fit bushing is similar to the headless type with the exception of the head or shoulder found on its top end. This bushing type is selected when high axial cutting forces are anticipated. The head prevents the bushing from being pushed through the bushing plate.

Fixed Renewable Bushings　A fixed renewable bushing is selected when the production life of the jig exceeds the normal wear life of one bushing. This bushing style is used with a press fit bushing liner and lock screw. The bushing slips into the liner and is held in place with a lock screw. When the bushing wears out, it can easily be replaces on the production floor.

Slip Renewable Bushings　Slip renewable bushing are also used with press fit-type liners. This bushing type is selected when more than one operation is to be completed on one hole using a single jig. In such a case, the hole is first drilled using one bushing, then that bushing is removed and replaced by a larger bushing sized to accommodate a reamer. In this manner, a hole can be drilled and reamed in the same jig. Both drill and reamer bushing will have identical outside diameters allowing them to fit perfectly into the liner.

Bushing Liners　Bushing liners, both headless and head types, are permanently pressed into the jig's bushing plate to protect it from wear when either fixed or slip renewable bushing are used. Headless liners are used when minimal axial loading is anticipated. Head liners are used when excessive axial cutting pressures are anticipated. The bushing plate is typically counterbore to allow a flush mounting of the liner's head.

Lesson 11 Electronic Components and System

An electronic component is a basic electronic element and is usually packaged in a discrete form with two or more connecting leads or metallic pads. Components are intended to be connected together, usually by soldering to a printed circuit board, to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator).

There are a large number of symbols which represent an equally large range of electronic components. It is important that you can recognize the more common components and understand what they actually do.

Diodes

Diodes are basically a one-way valve for electrical current. They let electrical current flow in one direction (from positive to negative) and not in the other direction. Most diodes are similar in appearance to a resistor and will have a painted line on one end showing the direction or flow (the other side is negative). If the negative side is on the negative end of the circuit, current will flow; If the negative side is on the positive side of the circuit, no current will flow (Fig. 11-1).

Transistors

There are two types of standard transistors, NPN and PNP, with different circuit symbols. The transistor is possibly the most important invention of this decade. It performs two basic functions: (1) It acts as a switch turning current on and off. (2) It acts as an amplifier. This makes an output signal that is a magnified version of the input signal (Fig. 11-2).

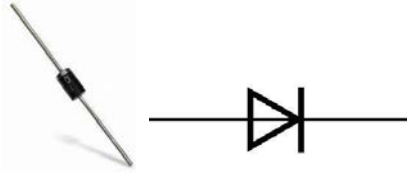


Fig. 11-1 diodes

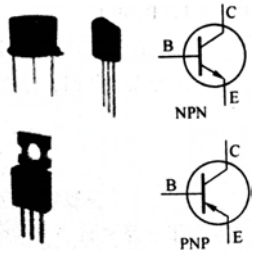


Fig. 11-2 transistors

Resistors

Resistors, like diodes and relays, are another electronic parts that should have a section in the installer's parts bin. They have become a necessity for the mobile electronics installer, whether it be for door locks, timing circuits, remote starts, LED, or just to discharge a stiffening capacitor (Fig. 11-3).

Resistors “resist” the flow of electrical current. The higher the value of resistance (measured in ohm), the lower the current will be.

Capacitors

A capacitor is a device used to store charge in an electrical circuit. A capacitor functions much like a battery, but changes and discharges much more efficiently (batteries, though, can store much more charge) (Fig. 11-4).

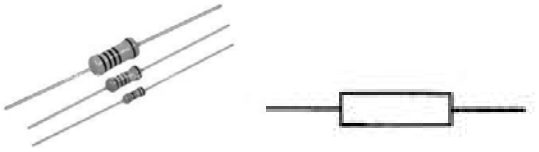


Fig. 11-3 resistors

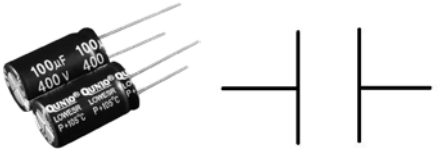


Fig. 11-4 capacitors

Relays

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches (Fig. 11-5).

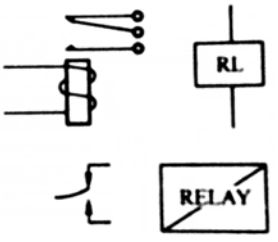


Fig. 11-5 relays

New Words

1. electronic [ilek'trɔnik]	*a*. 电子的
2. component [kəm'pəunənt]	*n*. 部件
3. element ['elimənt]	*n*. 元件
4. package ['pækidʒ]	*v*. 封装
5. discrete [dis'kri:t]	*a*. 离散的
6. metallic [mi'tælik]	*a*. 金属的
7. pad [pæd]	*n*. 垫片
8. solder ['səuldə]	*n*. 焊料，焊接 *v*. 钎焊
9. amplifier ['æmplifaiə(r)]	*n*. 放大器
11. oscillator ['ɔsileitə]	*n*. 振荡器
12. diode ['daiəud]	*n*. 二极管
13. positive ['pɔzətiv]	*n*. 正极

14. negative ['negətiv]	*n.* 负极
15. resistor [ri'zistə(r)]	*n.* 电阻器
16. magnify ['mægnifai]	*v.* 放大
17. stiffen ['stifən]	*v.* 硬化
18. capacitor [kə' pæsitə(r)]	*n.* 电容器
19. resistance [ri'zistəns]	*n.* 电阻
20. ohm [əum]	*n.* 欧姆
21. charge [tʃa:dʒ]	*n.* 电荷；*v.* 充电
22. conductor [kən'dʌktə(r)]	*n.* 导体
23. insulator ['insjuleitə(r)]	*n.* 绝缘体
24. dielectric [daii'lektrik]	*n.* 电介质
25. changeover ['tʃein(d)dʒəuvə(r)]	*n.* 转换

Phrases and Expressions

1. printed circuit board (PCB)	印制电路板
2. A large range of	大量的，大范围的
3. act as	作为
4. transistor	晶体管
5. timing circuit	定时电路
6. magnetic field	磁场
7. double throw switch	双向开关

Notes

1. It is important that you can recognize the more common components and understand what they actually do. 本句为主语从句。句中 recognize 和 understand 为并列结构；而 understand 又引导出一个宾语从句。全句可译为：认识常见的部件并了解它的功用是非常重要的。

2. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. 本句为并列句，由并列连词 so 引出。They 指代 relays。全句可译为：线圈中电流可被允许或阻止流过，所以继电器可处于两个开关位置，作为双向开关（转换开关）。

Exercises

Mark the following statements with T (True) or F (False) according to the passage.

1. An electronic component is a basic electronic element, which is often placed in a printed circuit board. (　　)

2. A diode is basically regarded as a two-way valve for electrical current. (　　)

3. One of three basic functions of transistors is that it acts as an amplifier. (　　)

Expand Knowledge　Basic Circuit Concept

The fig. 11-6 shows the basic type of electrical circuit, in the form of a block diagram. It consists of a source of electrical energy, some sort of load to make use of that energy, and electrical conductors connecting the source and the load.

The electrical source has two terminals, designated positive (+) and negative (-). As long as there is an unbroken connection from source to load and back again as shown in fig. 11-6, electrons will be pushed from the negative terminal of the source, through the load, and then back to the positive terminal of the source. The arrows show the direction of electric current flow through this circuit. The electrons are always moving in the loads, which can be any devices or circuits powered by electricity e.g. batteries, electricals generator, or some sort of electronic power supplies.

It can be as simple as light bulbs or as complex as modern high-speed computers.

The electricity provided by the source has two basic characteristics, called voltage and current.

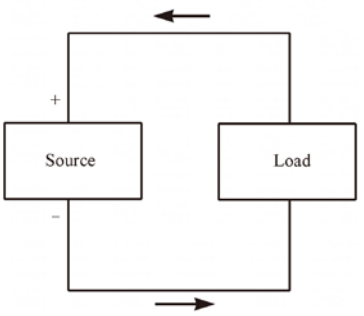


Fig. 11-6　electrical current

Lesson 12 Machining Center

HTM125600 turning and milling center adopts disposition of twin-turret, simultaneous five-axis control linkages, and it possesses the load capacity of heavy-duty lathe. The machine is mainly used to machine high accuracy, multifarious processes and complex shape gyro rotor parts. Such as motor rotor, turbine rotor, roller and crankshaft, with high accuracy, multi-process and complex shape. The machine can be used to machine workpiece in small and medium batch and various varieties, saving tooling disposition, shortening preparing cycle of production. Key parts are all imported from world famous enterprises to ensure the accuracy and reliability of the machine and increase productivity.

Features of Machine Structure

- Bed of the machine is found by high-strength cast iron with integral tank structure. There is a bevel rack (m=8) with high intensity imported from Italian LICAT behind the bed for driving the column.
- Headstock adopts thermostatic lubricating oil. Oil cooling cycle device is disposed on the outer front bearing.
- Main motor is larger power DC motor.
- Tailstock is consists of upper and lower parts and is provided with indicators that can separately display pushing force of weight of workpiece to be machined.
- The column is a side-hanging type structure and driving system is provided for feed of Z-axis to eliminate reversal clearance.
- A working feeding machanism is provided at each side of the column. The feeding box and the right of a ram structure X1 and X2 axis adopt double-driving to greatly increase the smoothness of motion; and the machine is equipped with tool changing manipulator and tool magazine and BLUM measuring tool device.
- Control box suspends from under of the machine, and it can be driven along Z-axis.
- With SIEMENS 840D numerical control system.

Major Specification (see Tab. 12-1)

Tab. 12-1 Major Specification

Item	Unit	Remark
Max. turning length	mm	6,000
Max. turning diameter	mm	ϕ1 250
Max. weight of workpiece between centers	kg	30 000
Range of spindle speed	r/min	1～200

（续表）

Output power of main motor	kW	75（直流 500～2 000r/m）
Dia. of face plate	mm	ϕ1 250（手动四爪）
Max. torque of face plate	kN·m	35
Max. torque of C-axis	N·m	1 200
Max. cutting force of single-tool	k·N	55
Travel of X_1 / X_2-axis	mm	1 330/790
Travel of Y_1-axis	mm	−300～+540（考虑换刀）
Travel of Y_2-axis	mm	±190
Travel of Z-axis	mm	8 130
Travel of B-axis		−90° ～ +180°
Travel of A-axis		0° ～ +90°
Speed of X_1/Y_1-axis rapid moving and feeding rate	mm/min	0～15 000/0～12 000
Speed of X_2/Y_2-axis rapid moving and feeding rate	mm/min	0～15 000/0～12 000
Speed of Z-axis rapid moving and feeding rate	mm/min	0～15 000
Max. speed of B-axis	r/min	30
Max. speed of C-axis	r/min	20
Dia. / travel of tailstock sleeve	mm	ϕ300/200
Rapid speed of tailstock moving	mm/min	3 500
Moving speed of tailstock sleeve	mm/min	660
Support range of steady rest (Optional)	Mm	ϕ150～ ϕ500
Power of boring and milling spindle	kW	52
Speed of boring and milling spindle step1/step2 (max.)	r/min	180/3 150
Spindle torque of boring and milling step1/step2 (max.)	Nm	2 400/157
Weight of the machine	kg	80 000
Overall dimensions of the machine (L × H × W)	mm	17 020 × 7 252 × 4 707

New Words

1. turning ['tə:niŋ] *n.* 车削
2. milling ['miliŋ] *n.* [机] 铣（削），铣削法；铣出的齿边
3. linkage ['liŋkidʒ] *n.* 连接；结合；联系；联动装置
4. disposition [ˌdispə'ziʃən] *n.* 安排；布置；支配；处理权
5. capacity [kə'pæsiti] *n.* 容量，容积；才能，能力
6. multifarious [ˌmʌlti'feəriəs] *a.* 许多的，多方面的；各式各样的
7. turbine ['tə:bin] *n.* 涡轮机
8. roller ['rəulə(r)] *n.* 滚压机；滚杠，滚柱；定型卷夹
9. rotor ['rəutə(r)] *n.* 转子，旋转器；[物] 旋度
10. crankshaft ['kræŋkʃɑ:ft] *n.* 机轴；曲轴，曲柄轴

11. productivity [ˌprɔdʌkˈtivəti] *n.* 生产率；生产力
12. eliminate [iˈlimineit] *vt.* 消除，排除；切断，分离
13. reversal [riˈvə:səl] *n.* 反向；反转；倒转；运气不好
14. clearance [ˈkliərəns] *n.* （公差中的）公隙，裕度，间隙，距离，容积
15. manipulator [məˈnipjuleitə(r)] *n.* 操作者；操纵者；操纵器
16. specification [ˌspesifiˈkeiʃn] *n.* 说明书，详细的计划书[pl.]，规范，规格，技术说明
17. torque [tɔ:k] *n.* 扭转力，转矩，项圈

Phrases and Expressions

1. twin-turret 双塔刀架
2. lubricating oil 润滑油
3. is consists of 由……组成

Notes

1. HTM125600 turning and milling center adopts disposition of twin-turret, simultaneous five-axis control linkages, and it possesses the load capacity of heavy-duty lathe.

HTM125600 车削和铣削加工中心采用双塔刀架，同时控制 5 轴联动，并拥有重型车床负载能力。

2. The machine is mainly used to machine high accuracy, multifarious processes and complex shape gyro rotor parts.

该机主要用于加工精度高、工序多和形状复杂的旋转零件。

3. The column is a side-hanging type structure and driving system is provided for feed of Z-axis to eliminate reversal clearance.

该立柱是一个侧面悬挂式结构伺服驱动系统，为 Z 轴提供进给，以消除反向间隙。

Exercises

1. What linkages does HTM125600 turning and milling center adopt?
2. Where are the key parts of HTM125600 turning and milling center imported?
3. Please say the features of machine structure.

Expand Knowledge　Maintenance and Fault Diagnosis of CNC Machine

Components of FANUC System are packed in detachable modules. There are 4 modules, namely：the computers with the interface, the drivers, the switching power supply and the transformer. The transformer takes a newly developed R-type structure of small size, high efficiency and noiseless. The switching power supply is specially designed for interference-free operation. The computer is packed on a two-layer printed-circuit-board to ensure high reliability. An individual driver-board is equipped for every axis and all the drivers are interchangeable. This flexible architecture provides great convenience in field maintenance, which turns out to be just the substitution of spare parts. The manufacturer provides spare parts as well as prompt services for the recovery of inactive component boards at reasonable prices.

The most common trouble that may occur in the system is the step-out of the stepper motor, and the following measures might be helpful in trouble shooting.

(1) Check all the voltages from the power supply board for the correct values.

(2) Switch to Manual Mode, drive the motor with pulsative step, and check the motor armature for regular motor by hand-touching. If the armature steps properly, feed step-out might be due to loosened fastening of the damper plate, which should be refitted and tightened; otherwise, (i.e.the armature does not step properly), the operation of the system must be subject to further inspection.

(3) Remove the cover of the chassis. Interchange the signal input plugs in the sockets (XS-9 and XS-10) on the driver PCB's of the proper motor and the abnormal motor, then check again the two motors in Manual Mode as described in 2. If the abnormal motor now runs properly, troubles might be in the driver PCB； otherwise, they may be due to failures in the computer.

(4) Check the voltage of the power input socket of the driver PCB (refer to Wiring Diagram), compare with the proper ones. When no voltage failures are found, check and compare the circuit components, mainly the power transistors, with an in-line measurement by a multimeter. Components with abnormal parameters might have been damaged.

(5) In case when the voltages are correct, another way of trouble-shooting is interchanging the driver PCB's of the proper and the abnormal stepper motor.

(6) Generally, small deviation in dimensions are due to mechanical hitches, while large deviation might be due to system circuitry troubles or loosened fastening of the motor damper.

(7) When step-outs emerge at high speed in dry run, the reduction gearbox should be examined.

(8) When no failures are found in separate inspections all the functional modules, yet the whole system works in unstable condition, the connecting cables should be carefully checked upon for soldering defects.

(9) When errors such as confusing displays or keyboard defects occur in the mainframe board, cut off the main source to the Control Unit Chassis and examine the insertion of the IC chips to ensure firm and sound connections.

We, the manufacturer, will provide various post-sales services to solve problems in the applications. Please contact us. We are ready to support and ensure the effective running of this system.

▶▶▶ Lesson 13　Computer Aided Manufacturing

Computer aided manufacturing (CAM) started with NC in 1949 at MIT. This project, sponsored by the U. S. Air Force, was the first application of computer technology to control the operation of a milling machine.

Standard NC machines greatly reduced the machining time required to produce a part or complete a production run of parts, but the overall operation was still time-consuming. Tape had to be prepared for the part, editing the program would result in making a new tape, and tapes had to be rewound each time a part was completed. With this in mind, the machine manufacturers added a computer to the existing NC machine, introducing the beginning of CNC.

The addition of the computer greatly increased the flexibility of the machine tool. The parts program was now run from the computer's memory instead of from a tape that had to be rewound. Any revisions or editing of the program could be done at the machine, and changes could be stored.

As the machine tool manufacturers continued to improve the efficiency of their machines, the computer capabilities were greatly increased to programmable microprocessors, and many time-saving devices were introduced to increase the machine's cutting time and reduce downtime. Some of these machine options are automatic tool changers, parts loaders and unloaders, chip conveyors, tool wear monitors, in-process gauging and robots—bring us to today's machining centers.

CAM uses all the advanced technologies to automate the operations in manufacturing and handle the data that drives the process. The tools of CAM include computer technologies, CAE, and robotics. CAM uses all these technologies to join the process of design with automated production machine tools, material handling equipment and control systems. Without computers, the most important tool in industry, the productivity of the United States would be in serious trouble. Computers help people to become more productive and to do things that would almost be impossible without them.

CAM ties together all the major functions of a factory. The manufacturing or production operations are joined together with the process planning, production scheduling, material handling, inventory control, product inspection, machinery control, and maintenance are formed a total manufacturing system.

A CAM system generally contains three major divisions：

Manufacturing　It controlls the physical operation of the machine tools, material handing equipment, inspection operations, etc. , in order to produce the parts required.

Engineering The process which involves design and engineering activities to ensure that the parts are designed properly in order to function as required.

Management The information such as scheduling, inventory control, labor, and manufacturing costs, and all the data required to control the entire plant.

CAM increases the productivity and versatility of machine tools. Before the introduction of NC and CAM, most machine tools were cutting metal only about 5% of the time. The automated systems available now cut metal about 70% of the time, and the goal is to come as close as possible to having them remove metal 100% of the available time.

New Words

1. revision [riˈviʒən]	*n.* 修正，修改
2. microprocessor [ˈmaikrəu/prəusesə(r)]	*n.* 微处理器
3. option [ˈɔpʃən]	*n.* 选项
4. automate [ˈɔ:təmeit]	*vt.* 使自动化
5. schedule [ˈʃedju:əl]	*vt.* 排定，安排；时间表；日程安排表
6. inventory [ˈinvəntəri]	*n.* 详细目录，存货清单

Phrases and Expressions

1. automatic tool changers	自动换刀架
2. in-process gauging	在线检测
3. machine centers	加工中心
4. time-saving	省时的

Notes

1. This project, sponsored by the U. S. Air Force, was the first application of computer technology to control the operation of a milling machine.

由美国空军倡导的这项技术，是计算机技术控制铣削加工的第一次应用。

sponsored by the U. S. Air Force 是插入语，做进一步说明。

2. Standard NC machines greatly reduced the machining time required to produce a part or complete a production run of parts, but the overall operation was still time-consuming.

标准的数控机床极大地减少了加工单一零件和完成零件整个生产过程所需要的加工时间，但整个加工仍然费时。

required 修饰 the machining time。

3. The parts program was now run from the computer’s memory instead of from a tape that had to be rewound.

零件加工程序运行于计算机存储器中，从而取代了须重绕的纸带。

4. As the machine tool manufacturers continued to improve the efficiency of their machines, the computer capabilities were greatly increased to programmable microprocessors, and many

time-saving devices were introduced to increase the machine's cutting time and reduce downtime.

随着机床生产厂家不断地提高机床效率，计算机编程微处理器的能力也极大地增强了，采用了很多节省时间的装置，用于切削加工的时间增加了，停机时间减少了。

downtime 意为停机时间。

5. Some of these machine options are automatic tool changers, parts loaders and unloaders, chip conveyors, tool weal monitors, in-process gauging and robots—bring us to today's machining centers.

有些机床具备自动换刀、零件自动装卸、切屑自动传输、自动监控刀具磨损、在线检测和机器人等功能——这就产生了现在的加工中心。

which 指代前面所提的各种功能。

6. The manufacturing or production operations are joined together with the process planning, production scheduling, material handling, inventory control, product inspection, machinery control, and maintenance are formed a total manufacturing system.

将制造或生产运行和工艺设计、生产计划、材料处理、仓储管理、产品检验、机器控制和维修联系在一起，形成一个完整的加工系统。

7. The automated systems available now cut metal about 70% of the time, and the goal is to come as close as possible to having them remove metal 100% of the available time.

现有的自动加工系统其加工时间占总时间的 70%。我们的目标是要使它们的切削时间尽可能地接近总时间的全部。

Exercise

Ⅰ. Translate the following expressions into Chinese.

1. the first application of computer technology
2. overall operation
3. making a new tape
4. each time a part was completed
5. the flexibility of the machine tool
6. improve the efficiency
7. programmable microprocessors
8. automatic tool changer
9. tool wear monitor
10. computer aided engineering（CAE）

Ⅱ. Choose the term which best matches the definition given in Column 2 from Column 1：

Column 1:

1. standard NC machines
2. automatic tool changers
3. the computer greatly increased

4. punched tape

5. a CAM system generally contains

Column 2

a. three major divisions：manufacturing, engineering, managment

b. can automatically change machine tools

c. greatly reduced the machine time

d. increased the flexibility of the machine tool

e. have to be prepared for the part before any machine can be done

Ⅲ. Translate the following passage into Chinese.

CAD/CAM systems can be used to produce CNC data to machine a part. After preparing a tool list and set up plan for the required part, the CNC programmer starts by creating a database. Once this database has been created, the programmer can recall the part on the CRT screen. After the part displayed, the programmer describes the tools required from the information in the tool library. This library contains a description and either a name or a tool identification number for each and every tool available for use.

Expand Knowledge　Useful Menu and Parameters For CAM

1. UG's Main Menu and Function (see Tab. 13-1)

Tab. 13-1　UG's Main Menu and Function

Menu	Function
File	New, Open, Close, Save, Save Work Part Only, Save As, Save All, Save Bookmark, Options, Print, Plot, Send to Package File, Import, Export, Utilities, Properties, Recently Opened Parts, Exit
Edit	Undo List, Redo, Cut, Copy, Copy Display, Paste, Paste Special, Delete, Selection, Object Display, Show and Hide, Transform, Properties, Curve, Feature
View	Refresh, Operation, Perspective, Orient, Layout, Visualization, Camera, Information Window, Current Dialog Box, Show Resource Bar
Insert	Sketch, Datum/Point, Curve, Curve from Curves, Curve from Bodies, Design Feature, Associative Copy, Combine Bodies, Trim, Offset/Scale, Detail Feature, Mesh Surface, Sweep, Facet Body, Direct Modeling
Format	Layer Settings, Visible in View, Layer Category, Move to layer, Copy to layer, WCS, Reference Sets, Group, Group Features
Tools	Expression, Spreadsheet, Material Properties, Update, Reuse Library, Customize, Drafting Standard, Journal, User Defined Feature, Part Families, Define Deformable Part
Assemblies	Context Control, Reports
Information	Object, Point, Expression, PMI, Part, Assemblies, Other
Analysis	Measure Distance, Measure Angle, Minimum Radius, Geometric Properties, Measure Bodies, Section Inertia, Examine Geometry, Strength Wizard, Simple Interference, Assembly Clearance, Space distance finder, Units kg-mm
Preferences	Object, User Interface, Visualization, Visualization Performance, 3D Input Devices, Work Plane, Modeling, Sketch, Assemblies, Annotation, PMI, beamcenter Intergration, NX Gateway, IT
Window	New Window, Cascade, Tile Horizontally, Tile Vertically, More
Help	

2. Parts Feature

Features	Feature Operations
Sketch	Draft Body
Extrude	Edge Blend
Revolve	Face Blend
Sweeping	Soft Blend
Sweep along Guide	Chamfer
Tube	Shell
Hole	Thread
Boss	Mirror Feature
Pocket	Mirror Body
Pad	Sew
Emboss	Patch Body
Offset Emboss	Wrap Geometry
Slot	Offset Face
Groove	Scale Body
Dart	Emboss Sheet
User Defined Feature	Split Body
Extract Geometry	Divide Face
Instance Geometry	Hole
Sheet from Curves	Trim Body
Bounded Plane	Join Face
Thicken	Instance Feature
Sheet to Solid Assistant	Unite
Datum Plane	Subtract
Datum Axis	Intersect
Datum CSYS	Assembly Cut
Block	Promote Body
Cylinder	Text Below Icon
Cone	Reset Toolbar
Sphere	
Spherical Corner	
Text Below Icon	

▶▶▶ Lesson 14　Computer Integrated Manufacturing System

Computer integrated manufacturing or CIM is the term used to describe the modern approach to manufacturing. Although CIM encompasses many of the other advanced manufacturing technologies such as computer numerical control (CNC), CAD/CAM, robotics, and just-in-time delivery (JIT), it is more than a new technology or a new concept. Computer integrated manufacturing is actually an entirely new approach to manufacturing or a new way of doing business.

To understand CIM, it is necessary to begin with a comparison of modern and traditional manufacturing. Modern manufacturing encompassed all of the activities and processes necessary to convert raw materials into finishes products, deliver them to the market, and support them in the fields. These activities include the following：

(1) Identifying a need for a product.

(2) Designing a product to meet the needs.

(3) Obtaining the raw materials needed to produce the product.

(4) Applying appropriate processed to transform the raw materials into finished products.

(5) Transporting product to the market.

(6) Maintaining the product to ensure a proper performance in the field.

This broad, modern view of manufacturing can be compared with the more limited traditional view that focuses almost entirely on the conversion processed. The old approach separates such critical pre-conversion elements (as market analysis research, development, and design for manufacturing), as well as such after-conversion elements (as product delivery and product maintenance). In the other word, in the old approach to manufacturing, only those processes that take place on the shop floor are considered manufacturing. This traditional approach of separating the overall concept into numerous stand-alone specialized elements was not fundamentally changed until the advent of automation. While the separate elements themselves became automated (i.e., computer aided drafting and design (CAD) in design and CNC in machining), they remained separate. Automation alone did not result in the integration of these islands of automation.

With CIM, not only are the various elements automated, but also the islands of automation are all linked together or integrate. Integration means that a system can provide complete and instantaneous sharing of information. In modern manufacturing, integration is accomplished by computers. With this background, CIM can now be defined as the total integration of all

manufacturing elements through the use of computers.

Progress is being made toward the eventual full realization of CIM in manufacturing. When this is accomplished, fully integrated manufacturing firms will realize a number of benefits from CIM:

(1) Product quality increases.

(2) Lead times are reduced.

(3) Direct labor costs are reduced.

(4) Product development times are reduced.

(5) Inventories are reduced.

(6) Overall productivity increases.

(7) Design quality increased.

New words

1. encompass [in'kʌmpəs]	*v.* 包含或包括某事物
2. delivery [di'livəri]	*n.* 递送；交付
3. performance [pə'fɔ:məns]	*n.* 履行；执行
4. conversion [kən'və:ʃən]	*n.* 变换；转化
5. advent ['ædvənt]	*n.* 出现；到来
6. background ['bækgraund]	*n.* 背景，后台
7. instant ['instənt]	*a.* 立即的，直接的
8. maintenance ['meintənəns]	*n.* 维护，保持

Phrases and Expressions

1. computer integrated manufacturing system（CIMS）	计算机集成制造系统
2. lead time = delivery time	交货时间，交货期；生产周期
3. be defined as …	被定义为……

Notes

1. It is more than a new technology or a new concept.

与其说它（CIM）是一个新的方法，还不如说它是一个新的概念。

句型… more than … or …意为“与其……不如……”。

2. Modern manufacturing encompassed all of the activities and processes necessary to convert raw materials into finished products, deliver them to the market, and support them in the fields.

现代制造包括了把原材料转换成成品、把产品投向市场和进行售后服务所必需的一切活动和过程。

necessary to do … 是形容词短语，作 the activities and processes 的后置定语，意为“必需……的”。

3. This traditional approach of separating the overall concept into numerous stand-alone specialized elements was not fundamentally changed with the advent of automation.

这种传统的将整个概念分割成许多独立的专用单元的方式并没有随着自动化的出现而发生根本性的变化。

分词短语 separating the overall concept into numerous stand-alone specialized elements 这里作介词 of 的宾语。

4. Progress is being made toward the eventual full realization of CIM in manufacturing.

在最终完全实现 CIM 的方向上制造业正在取得进展。

full realization of … 意为完全实现。

Exercise

Ⅰ. Place a“T”after sentences that are true and an“F”after those that are false.

1. CIMS is a new type of enterprise. (　　)

2. Transporting product to the market is not encompassed in modern manufacturing. (　　)

3. Traditional manufacturing encompasses all of the activities and processes necessary to convert raw materials into finished products. (　　)

4. While such separate elements as CAD or CAM themselves became automated, integration of these islands of automation will fully realize. (　　)

5. In modern manufacturing, integration is accomplished by computers. (　　)

Ⅱ. Answer the following questions.

1. What does CIMS means?

2. What’s the difference between modern and traditional manufacturing?

3. What can we benefit from CIMS?

Ⅲ. Fill the following blanks with appropriate words.

(　　) or CIM is the term used to describe the most modern approach to manufacturing. Although CIM encompasses many of the other advanced manufacturing technologies such as computer numerical control (　　), CAD / CAM, robotics, and just-in-time delivery (　　), it is more than a new technology or a new (　　). Computer integrated manufacturing is actually an entirely new approach to manufacturing or a new way of (　　).

To understand CIM, it is necessary to begin with a comparison of modern and traditional manufacturing. Modern manufacturing encompassed all of the activities and processes necessary to convert raw materials into (　　), deliver them to the market, and support them in the fields. These activities include the following.

This broad, modern view of manufacturing can be compared with the more limited (　　) view that focuses almost entirely on the conversion processed.

In the other word, in the old approach to manufacturing, only those processes that take place on the ( ) floor are considered manufacturing. This traditional approach of ( )the overall concept into numerous stand alone specialized elements was not fundamentally changed with the advent of automation. While the separate elements themselves became ( ), they remained separate. Automation alone did not ( ) in the integration of these islands of automation.

Expand Knowledge　Flexible Manufacturing Systems

The individual manufacturing system that were introduced here can be incorporated into a single large-scale system in which the production of part is controlled with the aid of a central computer. The advantage of such a production system is its high flexibility in terms of the small effort and short time required to manufacture a new product, and therefore it is denoted as a flexible manufacturing system (FMS).

Existing FMS in the United States are typically made up of machining centers working in concert with the types of machines, all under the control of a central computer. The work pieces are on pallets which move throughout the system, transferred by towlines (or drag chains) located beneath the floor or by some other mechanism. The FMS limits handling by the operators and can be more readily reprogrammed to handle new requirements.

Future FMS will contain many manufacturing cells, each cell consisting of a robot serving several CNC machine tools or other stand-alone systems such as an inspection machine, a welder, an EDM machine, etc. The manufacturing cells will be located along a central transfer system, such as a conveyor, on which a variety of different work pieces and parts are moving. The production of each part will require processing through a different combination of manufacturing cells. In many cases more than one cell can perform a given processing step. When a specific work piece approaches the required cell on the conveyor, the corresponding robot will pick it up and lead it onto a CNC machine in the cell. After processing in the cell, the robot will return the semi-finished or finished part to the conveyor. A semi-finished part will move on the conveyor until it approaches a subsequent cell where its processing can be continued. The corresponding robot will pick it up and load it onto a machine tool. This sequence will be repeated along the conveyor, until, at the route, there will be only finished parts moving, then they could be routed to an automatic inspection station and subsequently unloaded from the FMS. The coordination among the manufacturing cells and the control of the part's flow on the conveyor will be accomplished under the supervision of the central computer.

The advantages of FMS include the following：

(1) Increased productivity.

(2) Shorter preparation time for new products.

(3) Reduction of inventory of parts in the plant.

(4) Saving of labor cost.

(5) Improved product quality.

(6) Attracting skilled people to manufacturing (since factory work was regarded as boring and dirty).

(7) Improved operator's safety.

Additional economic savings may be from such things as the operator's personal tools, gloves, etc. Other savings are in locker rooms, showers, and cafeteria facilities—all representing valuable plant space, which will not require enlarging if company growth is achieved with flexible automation systems.

▶▶▶ Lesson 15　Introduction to Electromechanical Products and Negotiation

Place: Shanghai Industrial Fair, Exhibition hall of NC Machines

Characters: Mr Zhou. Sales representative of a NC Machine Manufacturer
Mr. Xu, Deputy-headmaster in charge of teaching in a institute
Mr. Jiang, Dean of Electromechanical Department
Mr. Shi, Dean of the Scientific Research Section

Zhou: How do you do? Welcome to see our products. What kind of equipment are you most interested in?

Jiang: I am interested in your MC (Machining Center) Machine, Model SV-1000. Would you show me a manual of Model SV-1000?

Zhou: OK. What's your name?

Jiang: My name is Jiang Zhongli. Here is my card. This is Mr. Xu, our deputy-headmaster and this is Mr. Shi, dean of our scientific research section.

Zhou: And here is my card. Thank you for coming. Are you also interested in MC?

Jiang: Yes, ours is a comprehensive key institute integrated with electromechanical, trade and foreign languages. We not only have the specialties such as electromechanical integration and technological foreign languages but also NC simulation center and CAD/CAM laboratory. With the support of Shanghai Municipal Educational Commission and the local bureau of finance, we'll make more investment in equipment.

Zhou: Oh, I see. I think you will mainly use the NC machine you are going to buy for teaching, won't you?

Jiang: Yes. Besides teaching and training, we'll also use it for scientific research and production. Therefore, we are very strict in choosing NC machines, which should meet the following requirements:
(1) Advanced technology.
(2) Multi-functionality.
(3) Higher precision which can meet the needs of teaching, scientific research and production.

Zhou: No problem. Established in 1943, our company has a long history and abundant

experience in manufacturing machine tools. We are highly praised by our customers because of high quality of our products and our excellent after-sales services. Our products are widely sold in the world. From the sample products, you can see that our products are superior in function and precision index to those similar products. There are 16 tools in the storage, which will make them change automatically. The working table can move forward and backward in a wide scale, which is completely fit for the processing of conventional mold. It has a high performance and is quite suitable for your institute and middle-sized enterprises.

Shi： Besides guaranteeing the structural functions, and the technical precision listed in the sample, can you add a fourth axis to make the four axes (X, Y, Z, and B) move simultaneously?

Jiang： There should be RS-232 communication set on your MC, which can support the CAD / CAM communication and finish the complicated surface by DNC (Direct Numerical Control).

Xu: In addition. would you please provide the attachments suitable for this model, such as shanks, cutters, and trolleys?

Zhou: OK, No problem.

Xu： Would you give us your quotation?

Zhu： How many NC machines do you want to order?

Shi： One.

Zhou： Let me think it over. 560,000 RMB.

Xu: Your quotation is on the high side.

Zhou： Considering the quality. I think our quotation is quite reasonable.

Jiang： Mr. Zhou, you know, colleges don't have a lot of funds and this time we have the rare chance to get the appropriation from the Municipal Educational Commission and Financial Bureau to renovate our NC training center. We have much equipment to buy and we are hard up for money. Please give us the most favorable price as your support for the educational cause.

Zhou： I have met three master hands in negotiation today (laughter). By the way, how would you make the payment?

Xu： I'll pay by installment.

Zhou： What about paying 30% upon signing the contract, and then paying the rest after delivery of the goods?

Xu: According to our practice, we'll pay 60% after delivery, and pay the additional 10% after 3 months' trial use.

Jiang： What about your after-sales services?

Zhou： We will ensure you "three warranties" (for repair replacement or compensation of faulty products) during one year period of guarantee. Then we'll ensure you follow up services. OK, just now you said that you also want to buy NC equipment?

Jiang: Yes, we want to buy WFC (Wire Flame Cutter), and EDM (Electric Discharge Machine).

Zhou: We can be your agent.

Xu: Mr. Zhou, let's decide 500,000 RMB for this NC machine. We'll discuss other equipment after we have done this one.

Zhou: I am afraid we can't. I don't think you'll let us sell the goods at a loss. I think we should decide it at 500,000 RMB. This is our lowest quotation, and no further concession. Actually, we won't make a profit. We will just use it as an advertisement.

Xu: Including freight?

Zhou: Um, OK.

Shi: When will you make the delivery?

Zhou: In about two months.

Xu: If you promise to deliver the goods 15 days ahead of time, We can accept your quotation.

Zhou: Please wait for a while, I'll talk it over with our manufacturing manager. Mr. Xu, I have just talked it over with Yang, our general manager. He agrees to your requirement of delivery, 15 days ahead of time.

Jiang: Mr. Zhou, during assembling the machine, can we go to your factory to learn from your technicians on how to test and adjust different kinds of precision index on the spot?

Zhou: Yes, you are welcome. You are experts in this line. We welcome you to supervise us. Please be assured that we'll use the advanced computer-laser feedback system to test and adjust the machine and make sure that every precision index will meet the requirements.

Shi: You can drop us a line.

Zhou: OK. Next, shall we sign a contract and a memorandum for the NC machine?

Xu: OK. Looking forward to mutual cooperation.

New words

1. exhibition [ˌeksiˈbiʃən] *n.* 展览，展览会
2. hall [hɔ:l] *n.* 门厅
3. representative [ˌrepriˈzentətiv] *n.* 代表；代理人
4. institute [ˈinstitju:t] *vt.* 建立；制定；开始；着手； *n.* 协会，学会；学院，研究院
5. equipment [iˈkwipmənt] *n.* 设备；装备；配备；（工作必需的）知识，技能
6. manual [ˈmænjuəl] *a.* 用手的；手工的； *n.* 手册，指南
7. deputy [ˈdepjuti] *n.* 副手；代理人，代表；议员，下院议员

8. comprehensive [ˌkɔmpri'hensiv] *a.* 广泛的，综合的
9. simulation [ˌsimju'leiʃən] *n.* 模仿；模拟
10. investment [in'vestmənt] *n.* 投资
11. municipal [mju'nisipl] *a.* 市的，市政的
12. commission [kə'miʃən] *n.* 授权，委托；委员会
13. technology [tek'nɔlədʒi] *n.* 科技（总称）；工艺；应用科学；工业技术
14. establish [is'tæbliʃ] *vt.* 建立，成立；安置
15. quality ['kwɔləti] *n.* 质，质量；品质；特征，特性
16. superior [sju'piəriə] *a.* （级别、地位）较高的；（品质、程度）优良的，较好的
17. index ['indeks] *n.* 索引；标志，象征；量度； *vt.* 给…编索引，指示出
18. performance [pə'fɔ:məns] *n.* 履行，执行；性能，工作情况
19. enterprise ['entəpraiz] *n.* 事业，计划；企[事]业单位，公司
20. guarantee [ˌgærən'ti:] *vt.* 保证；担保 *n.* 保证，保障；保证书；保用期
21. precision [pri'siʒən] *n.* 精确度；准确（性）
22. simultaneous [ˌsiməl'teinjəs] *a.* 同时发生的；同时存在的
23. communication [kəˌmju:ni'keiʃən] *n.* 交流；交际；通信
24. quotation [kwəu'teiʃən] *n.* 引用；引述；引文，引语，语录；时价，报价；行情
25. appropriation [əˌprəupri'eiʃən] *n.* 据为己有；占有；挪用（只指定用途的一笔）；拨款
26. renovate ['renəveit] *vt.* 翻新；修复；整修
27. installment [in'stɔ:lmənt] *n.* 部分；分期付款
28. sign [sain] *n.* 标记，符号
29. contract ['kɔntrækt] *vt.* 缔结；订契约； *n.* 契约，合同
30. warranty ['wɔrənti] *n.* 保证书；[律]（商品等的）保单
31. negotiation [niˌgəuʃi'eiʃən] *n.* 协商；谈判
32. profit ['prɔfit] *n.* 利润，收益，赢利；益处，得益
33. concession [kən'seʃən] *n.* 承认；允许；妥协，让步；特许权
34. technician [tek'niʃn] *n.* 技术人员，专家；技巧好的人
35. memorandum [ˌmemə'rændəm] *n.* （备忘的）记录；非正式商业书信，便函
36. mutual ['mju:tʃuəl] *a.* 相互的，彼此的；共同的，共有的
37. cooperation [kəuˌɔpə'reiʃən] *n.* 合作

Phrases and Expressions

1. Industrial Fair	工业博览会
2. deputy-headmaster	副校长
3. Electromechanical Department	机电系
4. the cocal bureau of finace	财政局

Notes

1. Yes, ours is a comprehensive key institute integrated with electromechanical, trade and foreign languages.

是的。我院是一所集机电、商务、外语于一体的综合性重点高等技术学院。

integrated with electromechanical, trade and foreign languages 是 institute 的后置定语。

2. We not only have the specialties such as electromechanical integration and technological foreign languages but also NC simulation center and CAD/CAM laboratory.

我院不但设有机电一体化和工业技术外语等专业，而且还有数控实训中心，CAD/CAM 实验室。

not only … but also … 不但……而且……

He not only studies hard but also works well.

他不仅学习努力，而且认真工作。

3. From the sample products, you can see that our products are superior in function and precision index to those similar products.

从展品上，你们可以看到其功能和技术精度指标优于其他同类产品。

superior 优势的，胜过……的(to; in)；超越……的(to)

be superior in numbers 数量上占优势

be superior to hardships 不屈服于艰难困苦

4. The working table can move forward and backward in a wide scale, which is completely fit for the processing of conventional mold.

工作台范围较大，完全可以胜任常规的模具加工。

Exercises

Please translate the following phrases into Chinese.

1. Exhibition hall of NC Machines
2. deputy-headmaster
3. in charge of
4. the cocal bureau of finace
5. machine tool
6. sign the contract
7. agree to
8. look forward to

Expand Knowledge Operation Panel of the CNC System

7.2″ Monochrome LCD/MDI Panel (see Fig. 15-1)

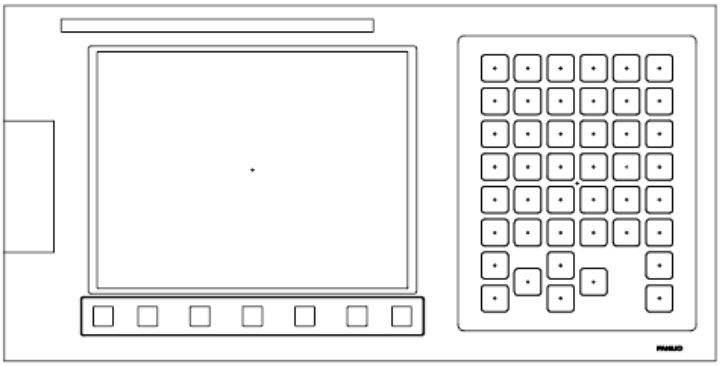


Fig. 15-1 7.2″ Monochrome LCD/MDI Panel

14″ color CTR/MDI Panel (see Fig. 15-2)

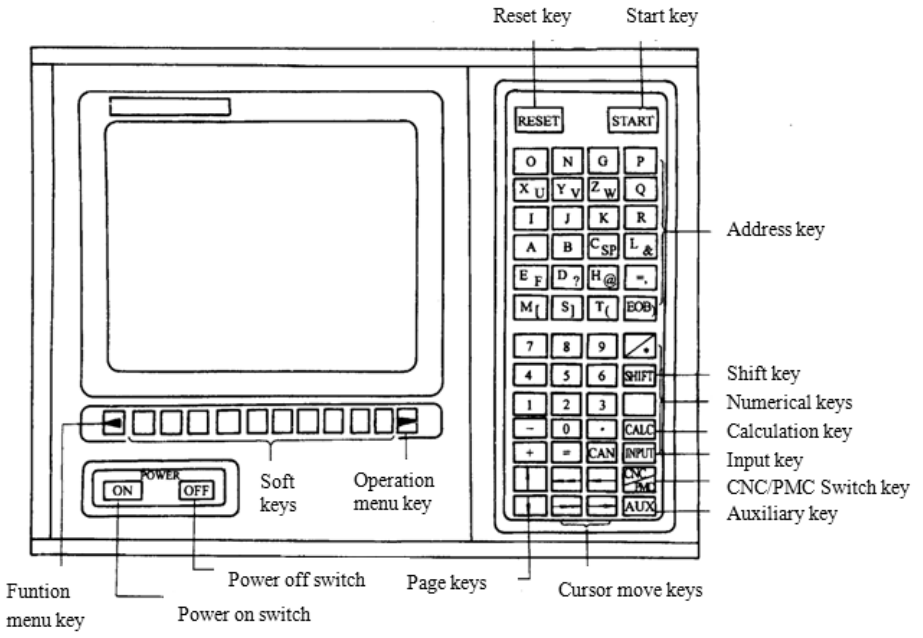


Fig. 15-2 14" color CRT/MDI Panel

Key Location of MDI (see Fig. 15-3)

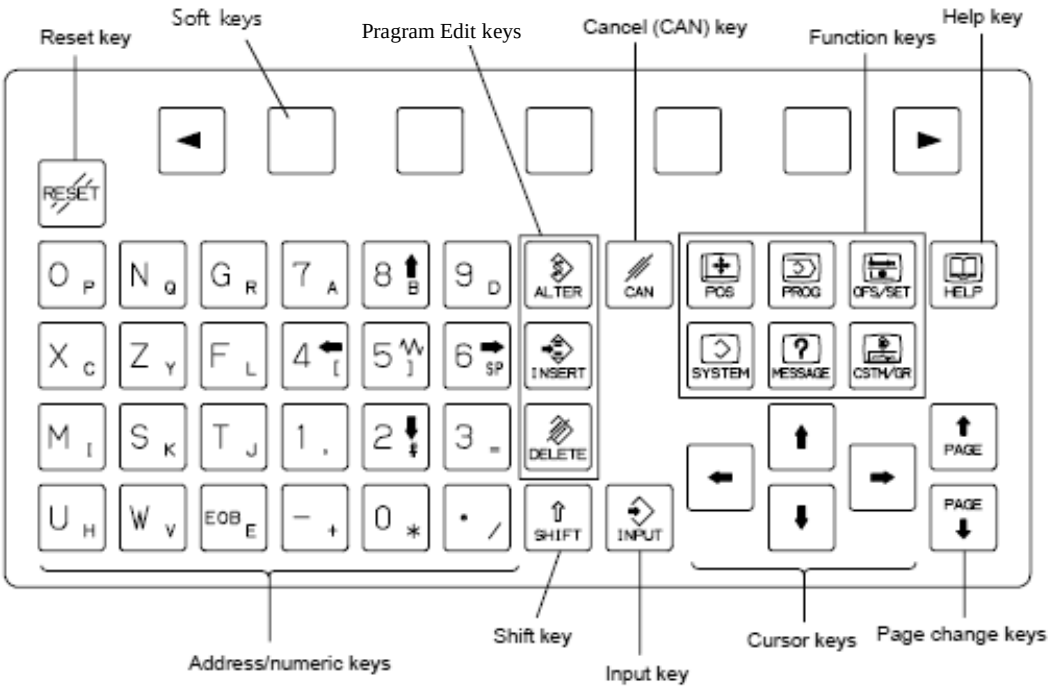


Fig. 15-3 Key Location of MDI

Explanation of the MDI Keyboard

1. Reset Key

Press this key to reset the CNC, to cancel an alarm, etc.

2. Help Key

Press this key to display how to operate the machine tool, such as MDI key operation, or the details of an alarm which occurred in the CNC (Help function).

3. Soft keys

The soft keys have various functions, according to the applications. The soft-key functions are displayed at the bottom of the screen.

4. Address/numeric keys

Press these keys to input alphabetic, numeric, and other characters.

5. Shift key

Some keys have two characters on their keyboard. When pressing the Shift key switches the characters,a character Q is indicated at the bottom left corner on the screen.

6. Input key

When an address or a numerical key is pressed, the data is input to the buffer, and it is displayed on the screen. To copy the data in the key input buffer to the offset register, etc. , press the INPUT key. This key is equivalent to the INPUT key of the soft keys; the same results can be

obtained by pressing either of them.

7. Cancel key

Press this key to delete the last character or symbol input to the key input buffer. When the key input buffer displays

>N001 × 1000Z

and the cancel CAN key is pressed, Z is canceled and

>N00l × 1000__ is displayed

8. Program Edit keys

Press these keys when editing the program.

ALTER：Alteration

INSERT：Insertion

DELETE：Deletion

9. Function keys

Press these keys to switch display screens for each function.

Press this key to display the **position** screen

Press this key to display the **program** screen

Press this key to display the **offset/setting** screen

Press this key to display the **system** screen

Press this key to display the **message** screen

Press this key to display the **custom** screen (conversational macro screen) or graphics screen.

10. Cursor keys

There are four different cursor move keys.

→：This key is used to move the cursor to the right or in the forward direction. The cursor is moved in short units in the forward direction.

←：This key is used to move the cursor to the left or in the reverse direction. The cursor is moved in short units in the reverse direction.

↓：This key is used to move the cursor in a download or forward direction. The cursor is moved in large units in the forward direction.

↑：This key is used to move the cursor in a upload or reverse direction. The cursor is moved in large units in the reverse direction.

11. Page change keys

：This key is used to changeover the page on the screen in the forward direction.

：This key is used to changeover the page on the screen in the reverse direction.

▶▶▶ Lesson 16 Adjustment and Training of Installation of CNC Machines

A large quantity of NC equipment (such as Machining Center, Wire Flame Cutter, Electric Discharge Machine) are delivered to NC simulation center in a institute. Some NC equipment is fixed up and debugged by some technicians from the manufacturer. How the technicians are fixing and installing the NC and are training the users how to operate and maintain these new machines.

Place: Simulation Center in institute

Character: Mr. Zhou, an engineer from the manufacture
Mr. Li, Mr. Zhang, Mr. Shi and Miss You, technicians of the institute

Jiang: Hello, Mr. Zhou We have prepared the crane and transporting tools for this installation. Let's discuss how to install these machines and how to train us.

Zhou: We are responsible for the installation and adjustment of the equipment. You can divide into several groups to do the following things:

(1) Make an inventory according to the shipping list of the equipment.

(2) Help our engineers fix up these machines.

(3) Inspect the precision in accordance with some indexes of ex-factory set.

What do you think about it, Mr. Jiang?

Jiang: OK, you are very considerate, I agree with what you said.

Zhou: Mr. Jiang, to save time, let's install the three machines in groups?

Jiang: OK, Mr. Zhou and I will be responsible for making an inventory to Machining Center. Mr. Shi and Li for EDM, Miss You and Mr. Zhang for Flame Cutter.

(MC testing ground)

Jiang: Mr. Zhou, first let's recheck every index of the MC equipment in accordance with manufacturing precision, shall we?

Zhou: Yes, let's begin. I think there may be some changes in the original precision because of the bumping in transport. So, we should readjust them.

Jiang: OK. Since every index of geometric precision has met our standards, I want to design a part to finish on the machine, is it OK?

Zhou: Special sample and tools are needed.

Jiang: I've prepared everything.

Zhou: Oh, it's very complicated. There are many difficult processes such as milling the surface and the bench, pocket, drilling holes, tapping, free surface, and so on. I think that we'll undergo an examination today (laugh). It will test both the machine and the operators.

Jiang: That's not my aim. We are not familiar with the new equipment. I want to know the actual processing ability of this equipment in order to know what's to do, when we undertake some processing in future.

Zhou: OK, let's start.

Jiang: Mr. Zhou, you'd better prepare something on one side of the machine. I will send an NC program to you on the other side. What's Baud rate of the machine?

Zhou: 4,800 bps.

Jiang: Ready. Start.

Zhou: OK. The machine is beginning to process the sample. The tool is changed smoothly in magazine, milling the surface, milling the slots, drilling hole, tapping, and so on. All the processes are OK.

Jiang: Let's measure the finished sample. Oh, the precision fits with the requirements. Would you mind making up some sizes in this sample?

Zhou: That's right. After adjusting the value of the make up, we'll finish and measure it again.

Jiang: Now, that's very good. Size and precision totally meet the standards. Thank you very much.

(EDM testing ground)

Li: Mr. Shi, first of all, let's test the flatness and straightness of the working table, then the verticality of the principal axis against the working table. The above targets are within the precision limits of the delivery stipulation.

Shi: Next, can you test the two kinds of processing (rough and finish processing)?

Li: OK.

Shi: How do you guarantee the precision of processing?

Li: First, I guarantee the precision of the electrodes themselves; second, I guarantee the verticality of electrodes against the working table when installed; Finally, I select the proper processing parameters, for example, voltage current intensity, pulse breadth, clearance, frequency, and so on. All these should be accumulated through long-term experience.

Shi: Thank you.

(Flame Cutter testing ground)

You: Mr. Zhang, what should we pay attention to when processing Flame Cutter?

Zhang: First, avoid folding when tying the molybdenum wire; second, make sure of its proper tightness when screwing it. You should not screw it too tight, or it will break.

You: How can we improve the precision of flame cutter processing?

Zhang: First, pay attention to the coordination between the tightness and the feeding speed of the molybdenum wire; second, pay attention to the verticality of the molybdenum wire (try to use the straighter of electrode to correct its verticality); finally select the proper processing parameters according to different materials. This depends on accumulated experience, of course, there is an experimental data base available for reference.

You: Thank you.

New words

1. quantity ['kwɔntiti] *n.* 数目，数量
2. simulation [ˌsimju'leiʃən] *n.* 模仿；模拟
3. maintain [mein'tein] *vt.* 保持；继续；保养，维护；坚持；主张
4. crane [krein] *n.* 起重机，吊车，升降架，升降设备
5. transport [træns'pɔ:t] *vt.* 运送；流放； *n.* 运输，运输工具，激动，狂喜，流放犯［化］运输
6. installation [ˌinstə'leiʃən] *n.* 安装；设置；就职；装置，设备
7. bump [bʌmp] *vt.* & *vi.* 撞倒；冲撞； *n.* 碰撞，猛撞
8. pocket ['pɔkit] *n.* 袋，口袋； *vt.* 把……装入袋内；*a.* 袖珍的；小型的
9. undergo [ˌʌndə'gəu] *vt.* 经历；承受；遭受
10. verticality [ˌvə:ti'kæliti] *n.* 垂直性，垂直状态
11. electrode [i'lektrəud] *n.* 电极
12. molybdenum [mə'libdinəm] *n.* 钼
13. accumulate [ə'kju:mjuleit] *vt.* & *vi.* 堆积；积累
14. magazine [ˌmægə' zi:n] *n.* 刀库；自动储存送料装置；杂志，期刊
15. stipulation [ˌstipju'leiʃən] *n.*［不可数］规定；［可数］条款，条件

Phrases and Expressions

1. be responsible for 负责
2. in accordance with 按照
3. agree with 同意
4. be familiar with 熟悉
5. molybdenum wire 钼丝

Notes

1.Would you mind making up some sizes in this sample?

你不介意补充加工试件中某几个尺寸吧？

mind + doing 介意做某事

make up 补充，弥补。例如：

Work fast, to make up for lost time.

加紧工作，来弥补损失的时间。

You have to make up the French examination.

你必须补考法语。

I certainly will try to make up for it.

我一定会设法补救的。

2. Mr. Shi, first of all, let's test the flatness and straightness of the working table, then the verticality of the principal axis against the working table.

史先生，首先，让我们测试机床工作台面的平面度和直线度，然后，测试主轴对工作台的垂直度。

Exercises

Please translate the following phrases into Chinese.

1. Wire Flame Cutter
2. Electric Discharge Machine
3. in accordance with
4. be familiar with
5. Baud rate
6. make up
7. delivery stipulation
8. rough and finish processing

Expand Knowledge　Installation

1. Unpacking

In unpacking, the shipping list must be first examined to ensure the proper configuration of the required system.

All the parts, attachments and spare parts of the shipped system have then to be checked item by item according to the shipping list for their types, quantities and external appearances to exclude confusions, mistake packing, shortages and damages.

The Control Unit Chassis must be subject to a further inspection for the correct types, good mechanical fastening, and reliable electrical connections of all its component, such as PCB's switches and keys, transformers, and so forth (refer to the Control Unit Assembly, and the Wiring Diagram).

2. Mounting

Mount the Control Unit Chassis safely on the machine tool at a position convenient to operator. A cantilever bracket shown in Fig. 16-1 might be quite be helpful. In some systems, the driver circuitry with the power transformer are packed in a separate chassis, it should be fixed securely also.

Mount the stepper motors to the feed mechanism of machine tool.

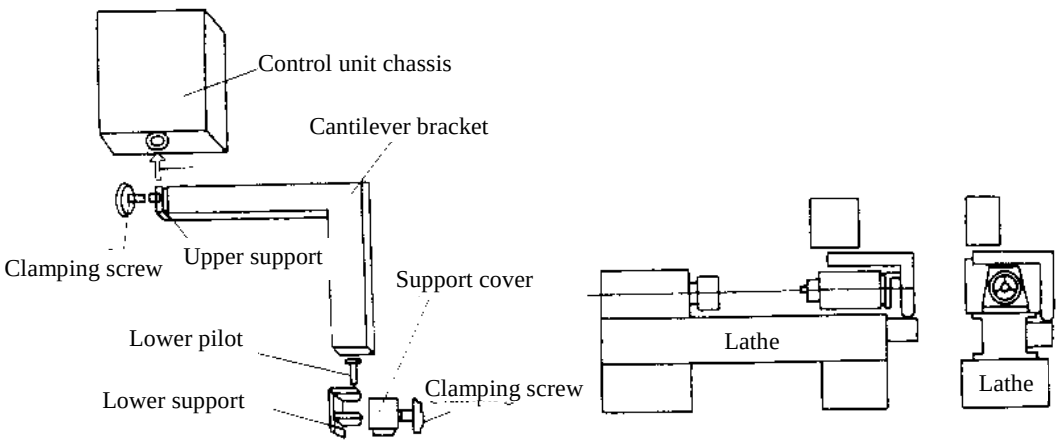


Fig. 16-1　Installation of Control Unit Chassis

(a) The Mounting Bracket；(b) Installation-1；(c) Installation-2

3. Powering-On

Connect the motor drives, the stepper motors and the main power supply to the Control Unit Chassis according to the Assembly and Wiring Diagram. Before the main source is turned on, the load button for the power amplifier must be set “OFF”. Turn on the main source switch, and the Control Unit is now put in form working. At this instant, the ventilator blowers must work properly, as the blowers prohibit the Control Unit work without the forced Ventilation. Then turn on the load button as that the Control Unit, the Drivers, and the stepper motors can be tested by manual operations. When the manual operation inspection verifies the correct performances of all the component parts, a simple PMP ought to be prepared and be inputted to the system to check the various functions. If these functions check are confirmed, the system can now be the motor drives for combined debugging.

4. Points for Attention

(1) If the rotation direction of the motor is found to be opposite to the presumed one, it can be reversed by interchanging the pin-connections of the connectors at the ends of the cable joining the driver board and the stepper motor.

NOTE：Be sure to interchange both the two pairs of connections simultaneously，as a single interchange of either of the two pairs will cause damages to the power transistor.

(2) The IC chip in the system must be prevented from being touched by fingers and are strictly forbidden from being plugged or extracted when energized. When soldering is necessary in maintenance, all the power source to the system must be cut-off first, and all the plugging between the computer mainframe and the peripherals should be disconnected. To avoid damage when soldering in-circuit elements, the power supply to the soldering iron must be cut off at the instant of soldering and the chip pins should be soldered with the residual heat of the iron.

(3) When the stepper motor is locked statically, there might be light high-frequency buzz, which is a normal phenomenon and needs no further care.

(4) When standing-by for a long period, the power amplifier must be switched off so as to minimize the power consumption and element depletion. For the same reason, longtime continuous fast feed over 4,000 mm/min is also irrational as it might bring damages to the power transistor.

(5) Once the system main source is cut off, the system must not be repowered within 10 seconds；similarly undue or frequent power on-off are prohibited as all these will cause defects in the computer and damages to the components.

(6) The characteristics of the VMOS high power transistors are strictly stipulated by the system, so all other types of transistors are prohibited for substitution.

(7) When connecting or disconnecting the plugs aid sockets, the main source must be cut off to secure safety for the system and the operator. Care should be taken to assure correct directions and steady insertion when mating them so as to avoid damages in the connectors.

(8) The framework of the control unit chassis is grounded, so the user must ensure the correct connection of the main source to guard the chassis from being energized, as an energized chassis frame will result in serious hazard.

▶▶▶ Lesson 17　Method of Replacing Battery for CNC Machine Tool（Ⅰ）

In a system using this CNC, batteries are used as follows(see Tab. 17-1)

Tab. 17-1　The use of the batteries

Use	Component connected to battery
Memory backup in the CNC control unit	CNC control unit
Preservation of the current position indicated by the separate absolute pulse coder	Separate detector interface unit
Preservation of the current position indicated by the absolute pulse coder built into the motor	Servo amplifier

Used batteries must be discarded according to appropriate local ordinances or rules. When discarding batteries, insulate them by using tape and so forth to preservent the battery terminals from short-circuiting.

Batteries for memory backup (3 vdc)

Part programs, offset data, and system parameters are stored in CMOS memory in the control unit. The power to the CMOS memory is backed up by a lithium battery mounted on the front panel of the control unit. The above data is not lost even when the main battery goes dead. The backup battery is mounted on the control unit at shipping. This battery can maintain the contents of memory for about a year.

When the voltage of the battery becomes low, alarm message “BAT” blinks on the display and the battery alarm signal is output to the PMC. When this alarm is displayed, replace the battery as soon as possible. In general, the battery can be replace within one or two weeks, however, this depends on the system configuration.

If the voltage of the battery becomes any lower, memory can no longer be backed up. Turning on the power to the control unit in this state causes system alarm 935 (ECC error) to occur because the contents of memory are lost. Clear the entire memory and reenter data after replacing the battery.

Therefore, We recommend that the battery is replaced once a year regardless of whether alarms are generated.

The power to the control unit must be turned on when the battery is replaced. If the battery is disconnected when the power is turned off, the contents of memory are lost.

Observe the following precautions for lithium batteries:

WARNING

If an unspecified battery is used, it may explode.

Replace the battery only with the specified battery (A02B-0200-K102.)

In addition to the lithium battery built into the CNC control unit, commercial D-size alkaline batteries can be used by installing the battery case externally (see Fig. 16-1).

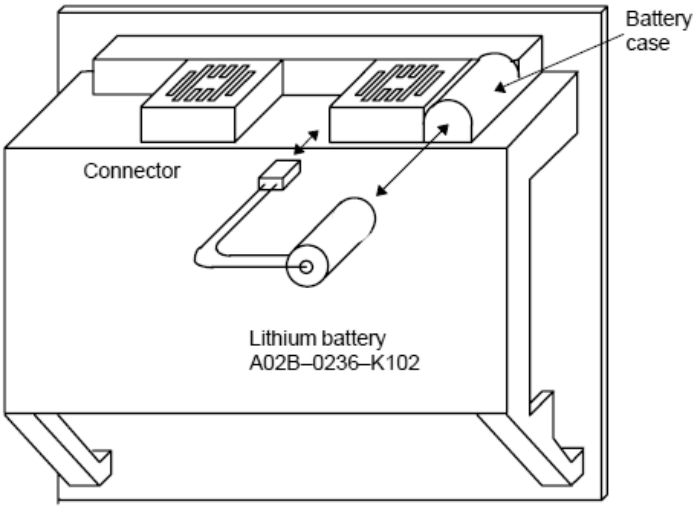


Fig. 16-1 Installing the battery

NOTE

A lithium battery is installed as standard at the factory.

(1) Prepare a new lithium battery (ordering drawing number: A02B-0200-K102).

(2) Turn on the power of the control unit once for about 30 seconds.

(3) Turn off the power of the control unit.

(4) Remove the old battery from the top of the CNC control unit.

First unplug the battery connector, then take the battery out of its case. The battery case of a control unit without option slots is located at the top right end of the unit. That of a control unit with 2 slots is located in the central area of the top of the unit (between fans).

(5) Insert a new battery and reconnect the connector.

NOTE

Complete steps (3) to (5) within 10 min. Do not leave the control unit without a battery for any longer than the period shown, as this will result in the contents of memory being lost.

WARNING

Incorrect battery replacement may cause an explosion. Do not use a battery other than that specified (specification: A02B- 0020-K102).

New words

1. battery ['bætəri]	*n.*（蓄）电池（组）
2. component [kəm'pəunənt]	*n.* 成分，组成部分；部件，元件
3. preservation [ˌprezə'veiʃən]	*n.* 保存，保藏，储藏，保持
4. ordinance ['ɔ:dinəns]	*n.* [正] 条例，法令
5. lithium ['liθiəm]	*n.* 锂
6. maintain [mein'tein]	*vt.* 保持；继续；保养，维护
7. external [ik'stə:nl]	*a.* 外面的，外部的；外观的，表面的
8. alkaline ['ælkəlain]	*a.* 碱的，碱性的
9. explosion [ik'spləuʒn]	*n.* 爆炸；爆发；激增，扩大
10. specification [ˌspesifi'keiʃn]	*n.* 说明书，详细的计划书
11. replacement [ri'pleismənt]	*n.* 代替；替换，更换
12. memory ['meməri]	*n.* 存储；存储器；记忆装置
13. connector [kə'nektə(r)]	*n.* 连接器；连接体；接插件

Phrases and Expression

1. backup battery	备用电池
2. discarding battery	丢弃的电池
3. servo amplifier	伺服放大器
4. the absolute pulse coder	绝对脉冲编码器
5. is mounted on	安装在

Notes

1. Preservation of the current position indicated by the absolute pulse coder built into the motor.

保存内置于电机的绝对脉冲编码器显示的当前位置。

built into the motor 是 the absolute pulse coder 的后置定语。

2. Used batteries must be discarded according to appropriate local ordinances or rules.

必须按照相应的地方法律法规丢弃废旧电池。

according to appropriate local ordinances or rules 是本句的状语。

3. Part programs, offset data, and system parameters are stored in CMOS memory in the control unit.

零件加工程序、刀具补偿和系统参数存储在控制单元的 CMOS 存储器中。

4. The power to the CMOS memory is backed up by a lithium battery mounted on the front panel of the control unit.

到 CMOS 存储器的电源由安装在控制单元前面板上的锂电池进行备份。

5. Therefore, We recommend that the battery is replaced once a year regardless of whether alarms are generated.

因此，我们建议不论是否产生报警，每年更换一次电池。

6. If the battery is disconnected when the power is turned off, the contents of memory are lost.

如果电池断开，电源被关掉，内存中的内容会丢失。

7. The battery case of a control unit without option slots is located at the top right end of the unit.

无选择插槽的控制单元电池盒位于机身顶部的右端。

8. That of a control unit with 2 slots is located in the central area of the top of the unit (between fans).

有 2 个插槽的控制单元，电池盒位于该单元顶部的中心区域（在风扇之间）。

Exercises

Answer the following question.

1. Where are batteries used in a system using this CNC?
2. By what is the power to the CMOS memory backed up?
3. How long can a lithium battery maintain the contents of memory?
4. When the battery is replaced, whether should the power to the control unit be turned on?
5. What happened when an unspecified battery is used?

Expand Knowledge　Method of Replacing Battery（Ⅱ）

Replacing the alkaline dry cells (size D)(see Fig. 16-2)

(1) Prepare two new alkaline dry cells (size D).

(2) Turn on the power of the control unit once for about 30 s.

(3) Turn off the power of the control unit.

(4) Remove the battery case cover.

(5) Replace the batteries, paying careful attention to their orientation.

(6) Replace the battery case cover.

> **NOTE**
>
> When replacing the dry cells, use the same procedure as that for lithium battery replacement procedure.

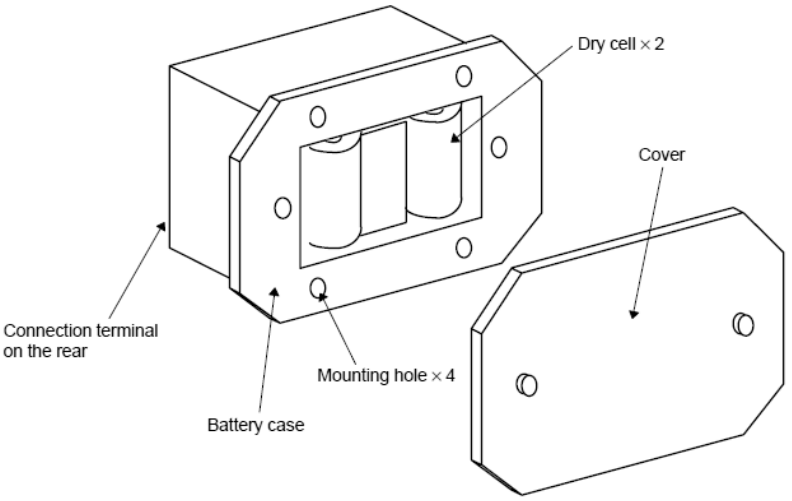


Fig. 16-2　Replacing the alkaline dry cells

Connection of alkaline dry cells (size D)

Power from the external batteries is supplied through the connector to which the lithium battery is connected (see Fig. 16-3). The lithium battery, provided as standard, can be replaced with external batteries in the battery case (A02B-0236-C281) according to the battery replacement procedures described above.

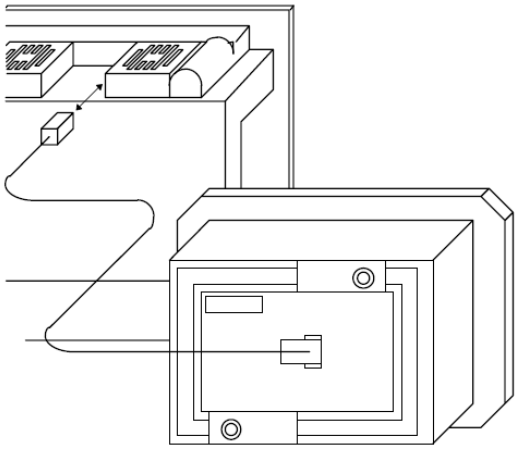


Fig. 16-3 Connection of alkaline dry cells (size D)

NOTE

(1) Install the battery case (A02B-0236-C281) in a location where the batteries can be replaced even when the control unit power is on.

(2) The battery cable connector is attached to the control unit by a mean of a simple lock system. To prevent the connector from being disconnected due to the weight of the cable or tension within the cable, fix the cable section within 50 cm of the connector.

Lesson 18 Automation Operation

Programmed operation of a CNC machine tool is referred to as automatic operation.

There are the following types of automatic operation.

Memory Operation

Operation by executing a program registered in CNC memory.

Mdi Operation

Operation by executing a program entered from the MDI panel.

Dnc Operation

Operation while reading a program from an input/output device.

Program Restart

Restarting a program for automatic operation from an intermediate point.

Scheduling Function

Scheduled operation by executing programs registered in an external input/output device.

Subprogram Call Function

Function for calling and executing subprograms registered in an external input/output device during memory operation.

Manual Handle Interruption

Function for performing manual feed during movement executed by automation operation.

Mirror Image

Function for enabling mirror-image movement along an axis during automation operation.

Manual Intervention And Return

Function restarting automation operation by returning the tool to the position where manual intervention was started during automation operation.

Memory Card-Based Dnc Operation

Automation operation by a program written to a memory card.

We will give an example: the memory operation of automatic operation:

Memory Operation

Programs are registered in memory in advance. When one of these programs is selected and the CYCLE START switch on the machine operator's panel is pressed, automatic operation starts, and the CYCLE START LED goes on.

When the FEED HOLD switch on the machine operator's panel is pressed during automatic operation, automatic operation is stopped temporarily. When the CYCLE START switch is pressed again, automatic operation is restarted.

When the RESET key on the MDI is pressed, automatic operation terminates and the reset state is entered.

The following procedure is given as an example. For actual operation, refer to the manual supplied by the machine tool builder.

Procedure for Memory Operation

1. Press the MEMORY mode selection switch.

2. Select a program from the registered programs. To do this, follow the steps below:

(1) Press PROG to display the program screen.

(2) Press address O.

(3) Enter program number using the numeric keys.

(4) Press the O SRH soft key.

3. For the two-path control, select the tool post to be operated with the TOOL POST SELECTION switch on the machine operator's panel.

4. Press the CYCLE START switch on the machine operator's panel. Automatic operation starts, and the CYCLE START LED goes on. When automatic operation terminates, THE CYCLE start LED goes off.

5. To stop or cancel memory operation midway through, follow the steps below.

(1) Stopping memory operation.

Press the FEED HOLD switch on the machine operator's panel. The FEED HOLD LED goes on and the CYCLE START LED goes off. The machine responds as follows:

① When the machine was moving, feed operation decelerates and stops.

② When dwell was being performed, dwell is stopped.

③ When M, S, or T was being executed, the operation is stopped after M, S, or T is finished.

When the CYCLE START switch on the machine operator's panel is pressed while the FEED HOLD LED is on, machine operation restarts.

(2) Terminating memory operation.

Press the RESET key on the MDI panel.

Automatic operation is terminated and the reset state is entered. When a reset is applied during movement, movement decelerates then stops.

After memory operation is started, the following are executed:

① A one-block command is read from the specified program.

② The block command is decoded.

③ The command execution is started.

④ The command in the next block is read.

⑤ Buffering is executed. That is, the command is decoded to allow immediate execution.

⑥ Immediately after the preceding block is executed, execution of the next block can be started. This is because buffering has been executed.

⑦ Hereafter, memory operation can be executed by repeating the steps ④ to ⑥.

New words

1. register ['redʒistə(r)]	*vt.* & *vi.* 记录；登记；注册
2. temporarily ['tempərərili]	*ad.* 临时
3. terminate ['tə:mineit]	*vt.* & *vi.* 结束；使结束，使停止，使终止；解除（契约等）
4. decelerate [ˌdi:'seləreit]	*vt.* & *vi.* （使）减速；降低速度，减速；慢化；制动
5. dwell [dwel]	*vi.* 留居；居住停留于
6. decode [di:'kəud]	*vt.* 译（码），解（码）
7. buffer ['bʌfə]	*n.* 缓冲器，减震器； *vt.* 缓冲，减轻
8. precede [ˌpri'si:d]	*vt.* & *vi.* （时间，位置，次序）在……之先[前]，领先于，在……之上；比……重要；在……前加上；为……加上引言（by，with）
9. command [kə'mɑ:nd]	*n.* 命令； *vt.* & *vi.* 指挥；控制
10. execution [ˌeksi'kju: ʃn]	*n.* 实行，执行

Notes

1. Operation by executing a program registered in CNC memory.

通过执行数控系统内存中的程序进行操作。

registered in CNC memory 是 program 的后置定语。

2. Restarting a program for automatic operation from an intermediate point.

从当前点重新启动一个程序进行自动运行。

3. Scheduled operation by executing programs registered in an external input/output device.

通过执行在外部输入/输出设备中的程序进行预定操作。

4. Function for calling and executing subprograms registered in an external input/output device during memory operation.

有在存储器操作中调用和执行外部输入/输出设备中子程序的功能。

registered in an external input/output device 是 subprograms 的后置定语。

5. When one of these programs is selected and the CYCLE START switch on the machine operator’s panel is pressed, automatic operation starts, and the CYCLE START LED goes on.

当选择这些程序中的一个，按下机床操作面板上的循环启动按钮，自动运行启动，并且循环启动灯亮起。

6. For the two-path control, select the tool post to be operated with the TOOL POST SELECTION switch on the machine operator’s panel.

对于两个路径的控制，用在机床操作面板上的刀架选择开关选择要操作的刀架。

Exercises

Translate the following into Chinese.

1. automatic operation
2. MDI
3. input/output device
4. manual feed
5. in advance
6. machine operator’s panel
7. cycle start switch
8. refer to

Expand Knowledge　Ultraprecision Machining

Beginning in the 1960s, increasing demands have been made for the precision manufacturing of components in computer, electronic, nuclear energy, and defense applications. Some examples include optical mirrors, computer memory disks, and drums for photocopying machines. Surface finish requirements are in the tens of nanometer (10^{-9}m or 10^{-3}μm) range and form accuracies in the μm and sub-μm range.

Because the cutting tool for ultraprecision machining applications is almost exclusively a single-crystal diamond, the process is also called diamond turning. The diamond tool has a polished cutting-edge with a radius as small as a few nanometers. Wear of the diamond can be a significant problem, and recent advances include cryogenic diamond turning, in which the tooling system is cooled by liquid nitrogen to a temperature of about −120℃.

The workpiece materials for ultraprecision machining to the date include copper alloys, aluminum alloys, silver, electroless nickle, infrared materials, and plastics (acrylics). The depth of cut involved is in the nanometer range. In this range, hard and brittle materials produce continuous chips (the process is known as ductile-regime cutting)；deeper cutting produce discontinuous chips.

The machining tools for these applications are built with very high precision and high machine, spindle, and work holding-device stiffness. These ultraprecision machines, parts of which are made of structural materials with low thermal expansion and good dimensional stability, are located in a dust-free enviroment (i.e., clean rooms) where the temperature is controlled to within a fraction of one degree.

Vibrations from internal machine sources as well as from external sources, such as nearby machines on the same floor, are also avoided as much as possible. Laser metrology is used for feed and position control, and the machines are equipped with highly advanced computer control systems and with thermal and geometric error compensating features.

Lesson 19 Test Operations（Ⅰ）

The following functions are used to check before actual machining whether the machine operates as specified by the created program.

(1) Machine Lock and Auxiliary Function Lock

(2) Feedrate Override

(3) Rapid Traverse Override

(4) Dry Run

(5) Single Block

1. Machine Lock And Auxiliary Function Lock

To display the change in the position without moving the tool, use machine lock, see Fig.19-1 There are two types of machine lock: all-axis machine lock, which stops the movement along all axes; and specified-axis machine, which stops the movement along specified axes only.

In addition, auxiliary function lock, which disables M, S, and T commands, is available for checking a program together with machine lock.

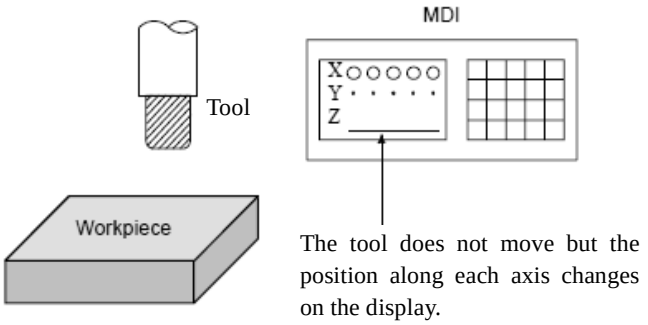


Fig. 19-1 Machine lock

(1) Procedure for Machine Lock and Auxiliary Function Lock

Machine Lock Press the machine lock switch on the operator's panel. The tool does not move but the position along each axis changes on the display as if the tool were moving.

Some machines have a machine lock switch for each axis. On such machines, press the machine lock switches for the axes, along which the tool is to be stopped. Refer to the appropriate manual provided by the machine tool builder for machine lock.

WARNING The positional relationship between the workpiece coordinates and machine coordinates may differ before and after automatic operation using machine lock. In such a case, specify the workpiece coordinate setting command or by performing manual reference position return.

Auxiliary Function Lock Press the auxiliary function lock switch on the operator's panel. M, S, T and B codes are disable and not executed. Refer to the appropriate manual provided by the machine tool builder for machine lock.

(2) Restrictions

[M, S, T, B COMMAND ONLY BY MACHINE LOCK] M, S, T, B commands are executed in the machine lock state.

[REFERENCE POSITION RETURN UNDER MACHINE LOCK] When a G27, G28, or G30 command is issued in the machine lock state, the command is accepted but the tool does not move to the reference position and the reference position return LED does not go on.

[M CODES NOT LOCKED BY AUXILIARY FUNCTION LOCK] M00, M01, M02, M30, M98, and M99 commands are executed even in the auxiliary function lock state. M codes for calling a subprogram(parameters No. 6071 to 6079) and those for calling a custom macro(parameter No. 6080 to 6089) are also executed.

2. Feedrate Override

A programmed feedrate can be reduced or increased by a percentage (%) selected by the override dial. This feature is used to check a program. For example, when a feedrate of 100 mm/min is specified in the program, setting the override dial to 50% moves the tool at 50 mm/min(see Fig. 19-2).

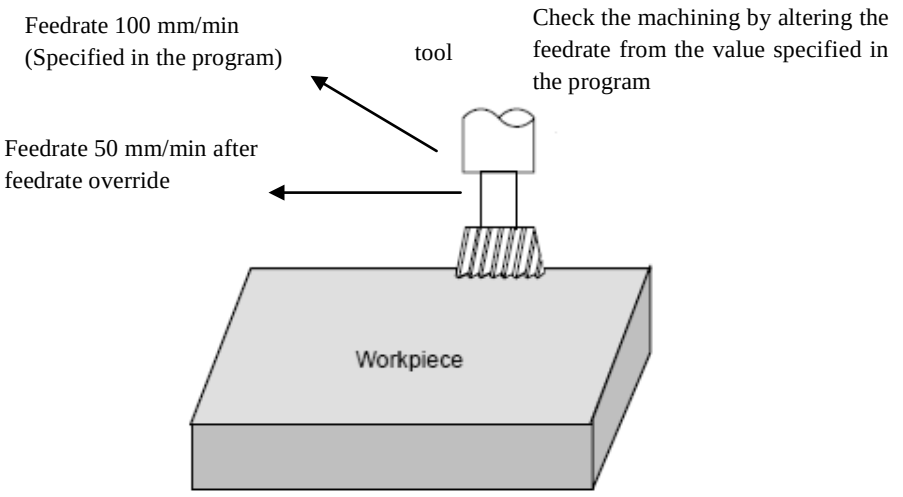
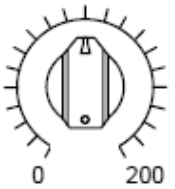


Fig. 19-2 Feedrate override

[Procedure for Feedrate Override]

Set the feedrate override dial to the desired percentage (%) on the machine operator's panel, before or during automatic operation.

On some machines, the same dial is used for the feedrate override dial and jog feedrate dial. Jog feedrate override, (see Fig. 19-3). Refer to the appropriate manual provided by the machine tool builder for feedrate override.



Jog feedrate override

Fig. 19-3

The override that can be specified ranges from 0% to 254%. For individual machines the range depends on the specifications of the machine tool builder.

During threading, the specified override is ignored; the override is always assumed to be 100%.

New words and Phrases

1. feedrate ['fi:dreit]	*n.* 进给速率
2. perform [pə'fɔ:m]	*vt.* & *vi.* 执行；履行
3. available [ə'veiləbl]	*a.* 可用的；可得到的
4. execute ['eksikju:t]	*vt.* 执行；实现；使生效

Phrases and Expressions

1. rapid traverse	快速进给；快速行程
2. dry run	空运行
3. jog feedrate override	点动进给倍率
4. in a canned cycle	在一个封闭的循环期内

Notes

1. There are two types of machine lock: all-axis machine lock, which stops the movement along all axes; and specified-axis machine, which stops the movement along specified axes only. In addition, auxiliary function lock, which disables M, S, and T commands, is available for checking a program together with machine lock.

有两种类型的机器锁：停止沿所有轴运动的所有轴机床锁和停止沿着指定的轴运动的指定轴机床锁。此外，能够使 M，S 和 T 指令丧失功能的辅助功能锁可用于检查程序和机床锁。

(1) which stops the movement along all axes 作 all-axis machine lock 的后置定语；which stops the movement along specified axes only 作 specified-axis machine 的后置定语。

(2) is available for 可得到的，be available for use 可加以利用。例如：

These tickets are available for one month.
这些票有效期一个月。
He is not available for the job.
他不适宜做这个工作。
This book is not available here.
这里没有这本书。
2. Refer to the appropriate manual provided by the machine tool builder for machine lock.
请参考由机床生产厂家提供的有关机器锁的手册。
provided by the machine tool builder for machine lock 作 manual 的后置定语。

Exercises

1. Which functions are used to check before actual machining?
2. What are the two types of machine lock?
3. How many instructions about the reference position?

Expand Knowledge Test Operations（Ⅱ）

3. Rapid Traverse Override

An override of four steps (F0, 25%, 50%, and 100%) can be applied to the rapid traverse rate. F0 is set by a parameter (No.1421). Rapid traverse override is show as Tab. 19-1. and Fig. 19-4.

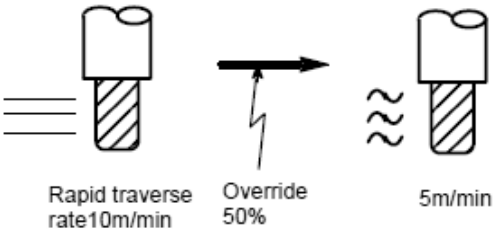
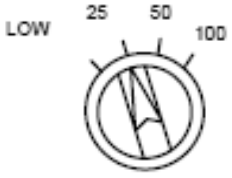


Fig. 19-4 Rapid traverse override

Tab. 19-1 Rapid Traverse Override

Procedure  Rapid traverse overtime	Select one of the four feedrate with the rapid traverse override switch during rapid traverse, see Fig. 19-4. Refer to the appropriate manual provided by the machine tool builder for rapid traverse override
Explanation	The following types of rapid traverse are available. Rapid traverse override can be applied for each of them. (1) Rapid traverse by G00 (2) Rapid traverse during a canned cycle (3) Rapid traverse in G27, G28, G29, G30, G53 (4) Manual rapid traverse Rapid traverse of manual reference position return

4. Dry Run

The tool is moved according to the feedrate specified by a parameter regardless of the feedrate specified in the program. This function is used for checking the movement of the tool under the state that the workpiece is removed from the table. Dry run is shown as Fig.19-5, and the procedure for dry run is shown as Tab. 19-2.

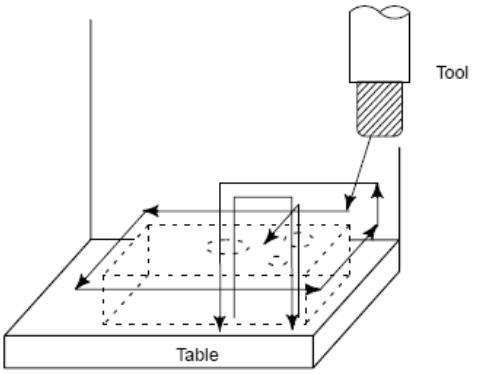


Fig. 19-5 Dry run

Tab. 19-2 Procedure for Dry Run

<table>
<tr><td>Procedure</td><td>Press the dry run switch on the machine operator’s panel during automatic operation.
The tool moves according to the feedrate specified by a parameter. The rapid traverse switch can also be used for changing the feedrate.
Refer to the appropriate manual provided by the machine tool builder for dry run.</td></tr>
<tr><td>Explanation
  </td><td>The dry run feedrate changes as shown in the table below according to the rapid traverse switch and parameters.
<table>
<tr><td rowspan="2">Rapid traverse button</td><td colspan="2">Program command</td></tr>
<tr><td>Rapid traverse</td><td>Feed</td></tr>
<tr><td>ON</td><td rowspan="2">Dry run speed × JV, or rapid traverse rate①</td><td>Dry run feedrate × Max. × JV②</td></tr>
<tr><td>OFF</td><td>Dry run feedrate × JV*2)</td></tr>
</table>
Max.cutting feedrate: Setting by parameter No.1422
Rapid traverse feedrate: Setting by parameter No.1420
Dry run feedrate: Setting by parameter No.1410
JV: Jog feedrate override</td></tr>
</table>

① Dry run feedrate × JV when parameter RDR (bit 6 of No. 1401) is 1. Rapid traverse rate when parameter RDR is 0.

JV: Jog feedrate override

② Clamped to the maximum cutting feedrate.

JV max. : Maximum value of jog feedrate override.

5. SINGLE BLOCK

Pressing the single block switch starts the single block mode, see Fig. 19-6. When the cycle

start button is pressed in the single block mode, the tool stops after a single block in the program is executed. Check the program in the single block mode by executing the program by block. Procedure for single block is shown as Tab 19-3.

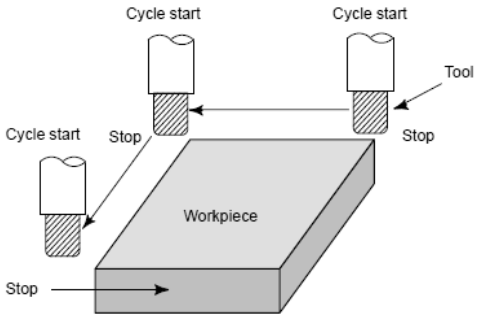
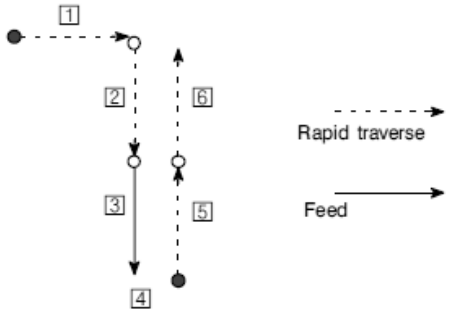


Fig. 19-6 (a) Single block

Tab 19-3 Procedure for Single block

Procedure	Press the single block switch on the machine operator's panel. The execution of the program is stopped after the current block is executed. Press the cycle start button to execute the next block. The tool stops after the block is executed. Refer to the appropriate manual provided by the machine tool builder for single block execution
Explanation	Reference position return and single block. If G28 to G30 are issued, the single block function is effective at the intermediate point. Single block during a canned cycle. In a canned cycle, the single block stop points are the end of point 1 or point 2, and point 6 shown as Fig.19-5 (b). When the single block stop is made after the point 1 or 2, the feed hold LED lights.  Single block stop is not performed in a block containing M98P, M99, or G65. However, single block stop is even performed in a block with M98P, M99 command, if the block contains an address other than O, N, P, L

▶▶▶ Lesson 20　Agency Agreement

This agreement is made and entered into this first day of May, 2009 by and between Huaxia National Chemical Import and Export Corporation, SINOCHEM, a corporation duly organized and existing under the laws of the People's Republic of China, with its principal place of business at (… Address …) (hereafter called the Seller/principle) and Galaxy Import and Export Corporation, a corporation duly organized and existing under the laws of the United States of America, with its principle place of business at (… Address …) (hereafter called Agent). Hereby it is mutually agreed as follows:

Article 1　Appointment

During the effective period of the agreement, Seller/principle hereby appoints the Agent as its exclusive agent to solicit orders/indents for the products stipulated in Article 3 and the agent accepts and assumes such appointment.

Article 2　The Agent's Duty

The Agent shall strictly conform with any and all instructions given by the seller to the Agent (from time to time) and shall not to make any representation, promise, contract, agreement or do any act binding the Seller. The Seller shall not be held responsible for any and all acts or failures to act by the Agent in excess of or contrary to such instructions.

Article 3　Commodity/Products

The product under the agreement shall be dyestuff produced by the Seller with the trademark "Diamond" (hereafter called the Product).

Article 4　Territory

The territory covered under this agreement shall be expressly confined to the United States of America (hereafter called the Territory).

Article 5　Exclusive Right

In consideration of the exclusive right herein granted, the Seller (principal) shall not, directly or indirectly, sell the Product in the Territory through other channels than the Agent; the Agent shall not sell, distribute or promote the sale of any product competitive with or similar to the Product in this territory and shall not solicit accept any order for the purpose of selling the Product outside the Territory.

Article 6　Minimum Transaction

During the first 12 months of the agreement, the Agent shall conclude transactions worth US $100, 000, US $140, 000 for the second 12 months and US $200, 000 for the third 12 months. In the event that the aggregate payment received by the Seller from the customers or others obtained by the Agent is less than the above stipulated amount in the respective period of the

duration of this agreement, the Seller shall have the right to terminate this Agreement by giving thirty (30) days' written notice to the Agent.

Article 7 Selling Price

The Seller shall from time to time furnish the Agent with the minimum prices and the terms and conditions of sales at which the Products are to be sold respectively.

Article 8 Orders

In soliciting orders, the Agent shall adequately inform customers of the general terms and conditions of the Seller's Sales confirmation. The Agent shall immediately dispatch any orders received to the Seller for its acceptance or rejection.

Article 9 Expenses

All expenses and disbursement in connection with the sales of the Product shall be for the Agent's account.

Article 10 Commission

The Seller shall pay the Agent commission in US dollars at the rate of 3% for the first 12 months, 4% for the second 12 months and 5% for the third 12 months of the net invoiced selling price of the Product on all orders directly obtained by the Agent and accepted by the Seller. Such commission shall be payable every six (6) months on the condition that the Seller receives the full amount of payments due to the Seller. Payment of commission shall be made by way of bank transfer.

Article 11 Market Report

The Agent shall report monthly to the seller about their inventory, market conditions and other activities.

Article 12 Promotion

The Seller shall furnish the Agent, free of charge, with a sufficient amount of promotional materials, such as literature, catalogues, leaflets and whatnot.

The Seller and the Agent shall together work out a promotion plan and schedule. The Agent shall diligently carry out the promotion plan and make necessary reports on the feedback impact of the promotional activity.

Article 13 Duration

This Agreement shall enter into force on the signing of both parties. At least three months before the expiration of the term, both the Seller and the Agent shall consult each other about renewal of this Agreement. If the renewal of this Agreement is agreed upon by both parties, this Agreement shall be renewed for another three years, with amendment, if agreed upon by both parties.

Article 14 Force Majeure

Neither party shall be held responsible for failure or delay to perform all or any part of their duties due to an act of God, government orders or restrictions or any other events which could not be predicted at the time of the conclusion of this Agreement and could not be controlled, avoided or overcome by the parties of this Agreement. However, the party effected by such

events of Force Majeure shall inform the other party of their occurrence in written form as soon as possible.

Article 15　Trade Terms and Government Law

The trade terms under this Agreement shall be governed and interpreted under provisions of *INCONTERM* 2000, and this Agreement shall be governed as to all matters under the laws of the People's Republic of China.

Article 16　Arbitration

All disputes arising from the performance of this Agreement should be settled through friendly negotiations. Should not settlement be reached, the case shall then be submitted to the China Economic and Trade Arbitration Commission for arbitration, and the rules of this Commission shall be applied. The award of the arbitration shall be final and bending upon both parties. The arbitration costs shall be borne by the losing party unless otherwise awarded by the Commision.

IN WITNESS THEREOF: This Agreement shall come into effect immediately after it is signed by both parties in two original copies; each party holding one copy.

Signed by_____in Beijing　　**Signed by**_____in Beijing

New words

1. agency ['eidʒənsi] *n.* 代理处；代理权
2. corporation [kəuˌɔpə'reiʃən] *n.* 公司，社团
3. duly ['dju:li] *ad.* 正确地，适当地；按时地，准时地
4. hereafter [hiər'ɑ:ftə(r)] *ad.* 今后，从此以后
5. hereby ['hiə'bai] *ad.*（用于公文件中的）以此方式；特此
6. exclusive [ik'sklu:siv] *a.* 专用的；独家的
7. solicit [sə'lisit] *vt.* & *vi.* 恳求，请求，乞求
8. indent [in'dent] *vt.* 订货，（向……）正式申请；*n.* 合同，国外订货单
9. stipulate ['stipjuleit] *vt.*（尤指在协议或建议中）规定，约定
10. representation [ˌreprizen'teiʃən] *n.*（总称）代表；代表制；表现，表示，代理
11. contract ['kɔntrækt] *vt.* & *vi.* 缔结；订契约；*n.* 契约，合同
12. contrary ['kɔntrəri] *a.* 相反的，相违的
13. commodity [kə'mɔditi] *n.* 商品；货物
14. dyestuff ['daistʌf] *n.* 染料
15. territory ['terətri] *n.* 领域，范围
16. confine [kən'fain] *vt.* 限制；局限于；*n.* 界限，范围
17. transaction [træn'zækʃn] *n.* （一笔）交易；（一项）事务
18. aggregate ['ægrigit] *n.* 合计；聚集；*a.* 合计的，聚集的

19. dispatch [dis'pætʃ]	*vt.* 派遣；快速处理
20. disbursement [dis'bə:smənt]	*n.* 支付款，支出额
21. invoice ['invɔis]	*vt.* 开……的发票
22. inventory ['invəntri]	*n.* 财产等的清单，详细目录，存货清单； *vt.* 把……编入目录
23. leaflet ['li:flit]	*n.* 传单，散页印刷品
24. whatnot [wɔtnɔt]	*n.* 类似的东西，诸如此类的东西
25. schedule ['ʃedju:l]	*n.* 时间表，日程安排表
26. arbitration [ˌɑ:bi'treiʃn]	*n.* 仲裁
27. commission [kə'miʃn]	*n.* 佣金，回扣
28. award [ə'wɔ:d]	*vt.* 授予；奖给；判给

Notes

1.This agreement is made and entered into this first day of May, 2009 by and between Huaxia National Chemical Import and Export Corporation, SINOCHEM, a corporation duly organized and existing under the laws of the People's Republic of China, with its principal place of business at (… Address …) (hereafter called the Seller/principal) …

本协议于 2009 年 5 月 1 日签订并生效。当事人一方是华夏化工进出口公司，简称“华夏化工”。该公司是按中国有关法律组建及活动的，其主营业地位于……（公司地址）（以下简称“卖方/委托人”）……

这句话中，enter into 表示进入……状态，例如 entered into combat readiness. (进入战争状态)。

2. During the effective period of the agreement, Seller/principle hereby appoints the Agent as its exclusive agent to solicit orders/indents for the products stipulated in Article 3 and the Agent accepts and assumes such appointment.

本协议的有效期内，卖方/委托人指定代理商为本协议第三条项下商品的独家代理。代理商同意并接受上述委托。

合同中的语言很严谨，译成中文时应注意译文要符合中文语言的逻辑关系。例如 the Agent accepts and assumes such appointment 直译成中文是代理商接受并承担上述委托。但是，如果译成“代理商同意并接受上述委托”，则不仅语言通顺，也符合中文语言逻辑关系。

3. The Agent shall immediately dispatch any orders received to the Seller for its acceptance or rejection.

代理商应立即将收到的订单转交卖方确定是否接受。

（1） received 是后置定语，修饰 orders。

（2） for its acceptance or rejection.作状语。

4. The Agent shall diligently carry out the promotion plan and make necessary reports on the feedback impact of the promotional activity.

代理商应努力执行促销计划，并将促销活动的效果及反馈信息向卖方做必要的汇报。

5. Neither party shall be held responsible for failure or delay to perform all or any part of their duties due to an act of God, government orders or restrictions or any other events which could not be predicted at the time of the conclusion of this Agreement and could not be controlled, avoided or overcome by the parties of this Agreement.

协议任何一方对由自然灾害、政府采购的限制及其他双方在签约时无法预料、无法控制且不能避免和克服的事件而导致的不能或暂时不能改选全部或部分协议的义务不承担责任。

这里 an act of God 是指不可抗力（如风暴、地震等）。

Exercises

Turn the following into Chinese.

1. We'd like to renew our sole agency agreement for another two years.
2. Since the agency agreement was signed, your turnover has amounted to $50,000.
3. The agency agreement has been drawn up for the period of one year.
4. Our agency agreement calls for a timely market report.

Expand Knowledge Sales Contracts

No.:_____

Signed at:_____

Date:_____

Seller:_____

Address:_____

Tel:_____Fax:_____

E-mail:_____

Buyer:_____

Address:_____

Tel:_____Fax:_____

E-mail:_____

The undersigned Seller and Buyer have agreed to close the following transactions according to the terms and conditions set forth as below.

1. Name, Specifications and Quality of Commodity:

2. Quantity:

3. Unit Price and Terms of Delivery: The terms FOB, CFR, or CIF shall be subject to *the International Rules for the Interpretation of Trade Terms (INCOTERMS 2007)* provided by International Chamber of Commerce (ICC) unless otherwise stipulated herein.

4. Total Amount:

5. More or Less:_____%.

6. Time of Shipment: Within_____days after receipt of L/C allowing transhipment and partial shipment.

7. Terms of Payment: By Confirmed, Irrevocable, Transferable and Divisible L/C to be available by sight draft to reach the Seller before_____and to remain valid for negotiation in China until_____after the Time of Shipment. The L/C must specify that transshipment and partial shipments are allowed.

The Buyer shall establish a Letter of Credit before the above-stipulated time, failing which, the Seller shall have the right to rescind this Contract upon the arrival of the notice at Buyer or to accept whole or part of this Contract non fulfilled by the Buyer, or to lodge a claim for the direct losses sustained, if any.

8. Packing:

9. Insurance: Covering_____Risks for_____110% of Invoice Value to be effected by the_____.

10. Quality/Quantity discrepancy: In case of quality discrepancy, claim should be filed by the Buyer within 30 days after the arrival of the goods at port of destination; while for quantity discrepancy, claim should be filed by the Buyer within 15 days after the arrival of the goods at port of destination. It is understood that the Seller shall not be liable for any discrepancy of the goods shipped due to causes for which the Insurance Company, Shipping Company, other Transportation Organization /or Post Office are liable.

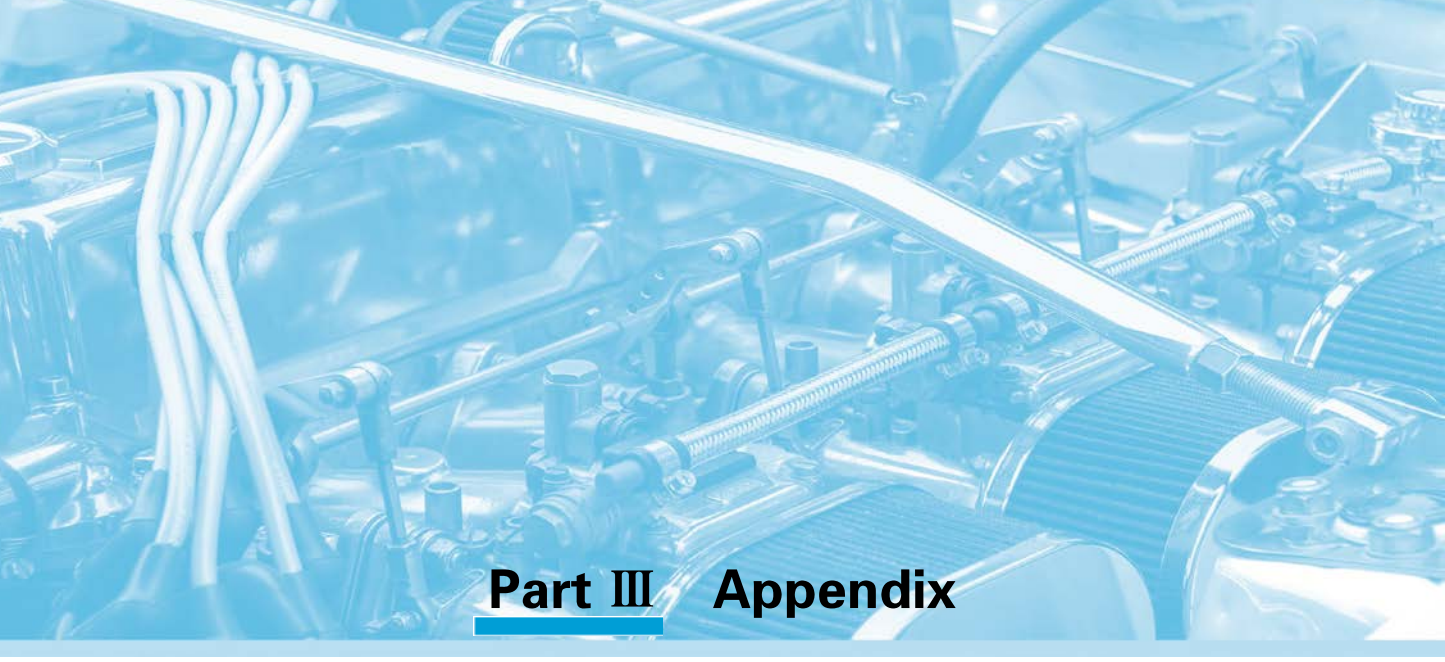
11. The Seller shall not be held responsible for failure or delay in delivery of the entire lot or a portion of the goods under this Sales Contract in consequence of any Force Majeure incidents which might occur. Force Majeure as referred to in this contract means unforeseeable, unavoidable and insurmountable objective conditions.

12. Arbitration: Any dispute arising from or in connection with the Sales Contract shall be settled through friendly negotiation. In case no settlement can be reached, the dispute shall then be submitted to China International Economic and Trade Arbitration Commission (CIETAC), Shenzhen Commission for arbitration in accordance with its rules in effect at the time of applying for arbitration. The arbitral award is final and binding upon both parties.

13. Notices: All notices shall be written in _____ and served to both parties by fax/E-mail/courier according to the following addresses. If any changes of the addresses occur, one party shall inform the other party of the change of address within ____ days after the change.

14. This Contract is executed in two counterparts each in Chinese and English, each of which shall be deemed equally authentic. This Contract is in _____ copies effective since being signed/sealed by both parties.

The Seller: The Buyer:



Part Ⅲ Appendix

Appendix Ⅰ The Characteristics of Scientific English

科技英语的特点

随着科学技术的发展和经济技术交流的增长，英语已被公认是国际上主要的科技语言。全世界的科学家、工程技术人员，以及攻读某一专业的学生都需要阅读日益增多的以英语撰写的科技文献资料、科技文章和教科书。这种表达科技概念、理论及叙述事实的英语，统称为科技英语（English for Science and Technology，EST）。

虽然科技英语并非与日常会话英语和英语文字语言截然不同，但它确实有自身的特点和风格。了解这些特点，并在反复的阅读实践中不断地熟悉这些特点，有助于迅速提高阅读理解能力，这样才能充分发挥科技英语在科技工作中的作用。

这里拟就科技英语书面语的主要特点做一扼要介绍。

一、科技英语的一般特点

科技文章与文艺小说、新闻报道等的文体风格迥然不同，力求严谨周密、概念准确、逻辑性强、行文简练、重点突出、句式严整，具有严肃书面体风格。

下面摘录两段科普文章，以说明普通英语（A）与科技英语（B）的某些不同特点。

A

We made a hole in a cork and pushed into it a narrow glass tube. Then we pushed this into the neck of a bottle which we had filled with colored water. When we did this, some of the colored water went up into the tube. We marked the level of the colored water into the tube. Then

we put the bottle into a pan of hot water.

Almost at once, the water level in the tube went down a little, but then it started to go up until the water poured out over the top.

B

After a hole was made in a cork, a narrow glass tube was inserted and the cork was inserted into the neck of a bottle filled with colored water. On doing this, some of the colored water rose in the tube. The level of the colored water in the tube was marked. Then the bottle was placed into a pan of hot water.

Almost immediately, the water level in the tube fell slightly, but then it started to rise until the water overflowed.

上面 A 和 B 谈及同一内容，但在用词方面的不同是显而易见的。

1. to push into = insert（嵌入）
2. which we had filled = filled（装有）
3. when we did this = on doing this（这样做时）
4. to go up = to rise（上升）
5. to put = to place（放）
6. at once = immediately（立刻）
7. a little = slightly（一点儿）
8. to pour out over the top = to overflow（溢出）

一般来说，科技文章文体的特点可以概括为准确（precise）、精练（concise）、清晰（clear）、严密（restricted）。那么，这些语言结构特点是如何体现的呢？下面分别加以简要介绍。

二、词汇特点

科技英语中除了使用普通英语词汇以外，还使用大量的适合各门学科的半技术词汇、适用于特定学科专业的专业词汇，以及大量的规范动词。

（一）半技术词汇

半技术词汇是指那些既适用于普通英语又适用于科技英语，而且在不同专业领域中出现时，又具有不同词义的词汇。这类词汇是最难掌握的。例如，名词 cell，在普通英语中指“小房间”“单人牢房”“盒”“槽”等；而在生物学中指“细胞”，在原子能领域指“晶格”，在物理学中指“温差电偶”“热电元件”，等等。这种一词多义现象，是由于各行各业都尽量借用普通词汇来表达各专业不同的概念而造成的。常见的这类词汇很多，如 work, load, plant, reaction, flux, movement, revolution, solution, matter, mass, power, force, energy, efficiency, body, base, phase, centre, dog 等。

请注意下面例句中 power 的不同词义。

I will do everything within my power to help you。

我愿意尽我的全力来帮助你。（能力）

The transistor can go from an OFF condition to an ON condition with great speed and

minimal power.

晶体管能以极高的速度和极小的功率由“关”的状态转换到“开”的状态。（功率）

With the development of electrical engineering, power can be transmitted over a long distance.

随着电气工程的发展，电力能够输送到远距离之外。（电力）

The power plant driving the machines is a 200Hp induction motor.

驱动机器的动力设备是一台二百马力的感应电动机。（动力）

半技术词汇是科技英语词汇的重要组成部分，也是最难掌握的一类词汇。由于半技术词汇可能适用于不同学科和专业，阅读中遇到这类词汇时，必须从科技著作涉及的具体专业内容来判断词义。

（二）专业词汇

专业词汇是高度技术性词汇，一般为单义词，其词义精确而且适用面窄，往往只适用于某一特定专业。例如：electron（电子）、proton（质子）、neutron（中子）、bandwidth（频带宽度）、flip-flop（触发器）、polymerization（聚合作用）、oxygen（氧）、Jupiter（木星）、boring（镗削加工）、lathe（车床）、belt drive（带传动）、flexible coupling（挠性联轴节）、spur gear（直齿圆柱齿轮）、involute gear teeth（渐开线齿形齿轮）、mechanical brake（机械制动）等。

随着科学技术的发展，新词也不断地涌现。据有关资料统计，每年大约有 1500 个新词进入词库。如生态学（ecology）领域出现了新词 air pollution（空气污染）、noise pollution（噪声污染），甚至还有 thermal pollution（热污染）、visual pollution（视觉污染）、cultural pollution（文化污染），以及 spiritual pollution（精神污染）等。

上面举出的专业词汇只是沧海一粟。专业词汇表面上看起来令人眼花缭乱，实际上由于词义单一，记忆起来比半技术词汇容易得多。

（三）规范动词

日常英语习语中包括大量的短语动词，如 look over（检查、察看）、throw out（扔出、逐出）、find out（发现）等。这类短语动词中，有些具有词面意义，有些含有隐喻的意义，有的这两种意义兼而有之。在科技著作中，科技人员往往尽量使用规范动词来代替短语动词，以示态度严肃和表达的精练、确切。例如：

The valve has the effect of increasing the voltage.（用 increase 代替 make … greater)

This work was formerly done manually，but it is now mechanized.（用 mechanized 代替 carried out by machines)

科技英语中使用的规范动词数量最大。下面再举一些例子：

discover — find out（发现）

achieve — carry out（完成，进行）

compensate — make up（补偿）

remove from — take out of（从……取出）

consume — eat up（消耗）

oscillate — swing to and from（摆动）

forecast — tell in advance（预测）

convey — carry along（输送）

establish — set up（确立、建立）

exceed — go beyond（超过）

retain — keep in（保持）

不过也有一些日常英语中使用的短语动词，没有适当的规范动词可以轻易地替换。这就是为什么科技英语中也偶尔使用短语动词的理由。例如：

The boiler has to be shut down for inspection and repair. 该锅炉必须停火检修。

The metal bar is cut down to the right size. 把这根金属棒切割到适当长度。

总之，为避免传达模糊的易产生歧义的信息，科技英语崇尚词义明确的规范动词。

（四）简洁的修饰语和构词法

科技著作者力求文体简洁，能用一个词修饰的，绝不用短语和从句。下面列举的利用词缀法、合成法构成的新词较为普遍。

1. 形容词+名词

例如：internal diameter（内径）、stainless steel（不锈钢）、cast iron（铸铁）、hot iron（铁水）、ferrous steel（黑色金属）、wet grinding（湿磨法）。

2. 名词+名词

例如：carbon dioxide（二氧化碳）、spot weld（点焊缝）、oil well（油井）、wedge key（楔形键）。

有时也连续用两个或三个名词修饰一个名词。例如：

vacuum distillation unit（真空蒸馏装置）

值得注意的是，在名词作修饰语的结构中有多种修饰关系，因此不如其他定语那么容易确定。这些关系，见表 1。

表 1　名词作修饰语结构的多种修饰关系

关　系	举　例
A of B	lathe carrier = the carrier of a lathe（车床刀架）
A for B	a water pipe = a pipe for water
A with B	a surface plate = a plate with a (flat) surface
A which has B	a cylinder lathe = a lathe which has a cylinder
A used for B	elevator motor = motor used for an elevator（升降电动机）
A used for B-ing	a punch hole = a hole used for punching
A contains B	alloy steel = steel contains alloy（合金钢）
A made of (from) B	a brass bearing = a bearing made of brass（黄铜轴承）
A shaped like B	a horse shoe magnet = a magnet shaped like a horseshoe（马蹄形磁铁）
A operated by B	power saw = a saw operated by power（电动锯）
A for doing B	a gas meter = a meter for measuring gas（气量计）
A which dose B	a gas company = a company which supplies gas（煤气公司）

3. 利用词缀法构成新词

（1）动词+后缀构成形容词，如 workable metal = metal which can be worked（可加工的金属），worked metal = metal which has been worked（已加工的金属），working fluid = fluid which dose the work（工作流体）等。

可见，利用词缀法构词简直可以代替一个短句，非常实用、精练。下面是一些重要的后缀：

① 以后缀-able（-ible, -uble）结尾的形容词大多由相应的及物动词派生而来，在意思上一般是被动的，常译为“能……”“可……”，如 machinable steal 能加工的钢、controllable reaction 能控制的反应。

② 由动词加后缀-ive 和-ent、-ant 构成的形容词也属此类，如 effective range 有效范围（距离）、absorbent carbon 活性炭。

③ 凡能用于被动意义的动词，都可以加后缀-ed 用作形容词，其意义表示被动。如：heated metal 已加热的金属、machined parts 已加工的零件。

④ 由动词加后缀-ing 用作形容词时，其意义表示主动。如：circulating water 循环水、rotating flied 旋转磁场、cutting edge 切削刃、lubricating system 润滑系统。

（2）其他重要的前缀和后缀。为了使文本精练，科技文章中使用很多来自希腊语、拉丁语或法语的词汇。如果我们熟悉这些词的前缀或后缀所代表的意义，在阅读中就能很容易地猜出并记住这些词的词义。下面略举其中最常见的几种。

① em-、en-把名词或形容词派生为动词，例如，enable 使能……、enlarge 扩大、embrittle 使变脆。

② inter-（= between or among）表示在……之间，相互，例如，intersection 横断（切）、交叉点。

③ counter-（= against，opposition to）表示反，逆，对，例如，counterweight 配重、counterforce 反力。

④ sub-（= beneath，less than）表示在……下，次（低）于，例如，subassembly 部（组）件装配、subway 地（下）道。

⑤ in-表示在（向）内，进，入；非，无，例如，inlet（进）入口、inconstant 无规则的。

⑥ out-表示在（向）外，远；超过，例如，outlet 出口、outweigh 比……重（要）。

⑦ auto-表示自动（己，身），例如，automation 自动化、autostop 自动停止器（装置）。

⑧ multi-表示多，例如，multi-load 多负载。

⑨ hydro-表示水，流体，例如，hydro-motor 液压马达。

⑩ electr-表示电的，例如，electricity 电（学、气、力）。

⑪ -ics（= subject）表示学科，例如，mathematics 数学，statistics 统计学。

⑫ -free 表示无……的，没……的，例如，dust-free 无尘的。

⑬ -proof 表示防（耐、不、反）……的，例如，water-proof 防水的，shock-proof 防振的。

此外，具有否定意义的前缀有 de-、dis-、il-、im-、in-、ir-、non-、un-、mal-、mis-，这些前缀均表示不……、无……、非……等意义。

具有动作意义和动作结果的后缀有-tion、-sion、-al、-ance、-ence、-ag 等。动词后缀有-en、-ise、-ate、-fy 等。

三、文体特点

科技英语的文体以说明文为主，也有一定数量的论说文和少量记叙文。

（一）说明文

说明文是用来说明事物的形状、性质、功用或发展过程的。例如，用于介绍材料、产品、结构，描述实验过程、生产过程、工作原理、科研方法，或介绍一本著作、一篇文章，等等。

说明文的特点是主要用一般现在时表达，以突出所说明的科技问题不受特定时间和地点的限制，是客观存在的事实。在说明文体中，最常用的方法有以下六种。

1. 叙述

说明文体最常用的方法就是叙述，它集中体现了科技文本简洁明快的特点。例如：

The main components of the lathe are the headstock and tailstock at opposite ends of a bed, and a tool-post between them which holds the cutting tool. The tool-post on a cross-slide which enables it to move sidewards across the saddle of carriage as well as along it, depending on the kind of job it is doing.

这段文字叙述了车床的主要部件名称、位置以及部分功用，主要用一般现在时和定语从句来表达；每个词都有恰如其分的作用和含义，多一个词显累赘，少一个词则会使叙述内容不够精确。

2. 定义

为了对名词概念进行更本质的说明，定义性的语言结构也是不可缺少的。最常见的定义方法可用下面的公式来表达。

被定义名词 + is + 所属类别名词 + wh-word … 。其中，wh-word 代表引出阐述部分定语从句的相应关系词。例如：

An engineer is a person who designs machines, buildings or public works.

An alloy is metallic substance which is composed of two or more elements.

另外，上述公式中类别名词也可用动词-ing、for + 动词-ing 以及 with 引出的介词短语来界定类别名词。例如：

A tangent is a straight line touching a curve at once point.

A triangle is a plane figure with three sides.

A thermostat is a device for regulating temperature.

从以上例句可以看出，下定义的句子常用的系动词是“is”。有时也使用“be”的其他形式或“can be defined as”结构，但这些形式出现的频率较低。

3. 分类

分类列举是说明事物的重要方法，能使读者的认识加以深化和条理化。例如：

We can divide bearings into several types according to their position on the shaft.（我们可以根据轴承在轴上的位置将它分为几类。）

说明事务分类的表达方法主要有以下几种（均以简单例句代表其句型）：

（1）There are two kinds (types、sorts、classes、varieties) of bearings.

（2）Bearings are of two types (etc.)

（3）We can divide bearings into two kinds (etc.) according to …

（4）We can classify bearings according to …

（5）Bearings can (may) be divided into …

（6）Bearings can (may) be classified as …

利用上述某一种表示方法将要说明的事物分类之后，科技著作者还常常用 first，second，…，to begin with，another point，…，finally 等进行罗列，逐一详细说明。

4. 举例

举例常作为例句出现，是说明文体中不可缺少的表达方法。例如：

With certain metals, such as copper or iron, the change in resistance which attends on changes in temperature is relatively large—a fact which is utilized in the resistance thermometer, in which it is possible to measure temperature changes, as in the windings of an electric motor, for instance, by the change in resistance.（某些金属如铜或铁，其电阻随温度变化而变化的程度是相当大的——电阻温度计就是利用这一特点而研制的。例如，使用这种温度计能够根据电阻的变化来测定诸如电动机绕组的温度变化。）

上面一个长句中使用了 such as, as 和 for instance 来引导具体例证。举例常用的连接型插入语还有 for example, as an example, namely, that is, in particular, as an application, including 等。

另外，举例还可以用来补充“定义”或“分类列举”。

5. 比较和比拟

对不易理解的科技内容作类比说明，是帮助人们认识事物的重要方法。例如：

Like the human brain, a computer also has a memory.（比拟）

Steel is far stronger than cast-iron.（比较）

科技工作者为了做更精确的说明，也常用比较方法来补充“分类列举”的内容。例如：

Engines used on ships include the diesel engine and the steam engine. A diesel engine is at least 50 percent more efficient than a steam engine.

6. 对比

为了说明问题的另一方面或表示相反意见，科技著作者还经常采用对比说明的方法，请看下面的例句：

The centrifugal pump is compact and requires little maintenance. But it suffers from certain disadvantages.

上述第一句说明“离心泵”的优点，第二句以 But 开头引出问题的另一方面，指出“离心泵具有某些特点”。这类表示对比的常见句型有 but, instead, nevertheless, however, on the other hand, in contrast, in the contrary, conversely, in fact, yet。其中 in fact 也可以用来表示强调。

以上是说明文体中经常使用的六种方法。除此以外，科技文献资料或教科书中还经常用图表或公式进行说明。

（二）论说文

论说文也是科技书面英语中常见的文体。由于在内容安排上要求有必然的逻辑联系，因此其主要特点是逻辑严密。为了使逻辑性更强，内容层次更清楚，论证更有力，科技著作者主要使用以下五类词语。

（1） 表示因果关系、依据或原因。例如，thus, as a result, therefore, as a result (of), hence, thereby, result in, so that, lead to, such … as to, consequently, because (of), owing to, since, due to, as, depend on, in view of, (be) dependent on, for this reason, according to, the reason why … is (was) that … 等。

（2）表示前提、条件的有 if, suppose, even if, assume, only if, assuming, provided that, let, providing, when, unless, in case of, once, on（+动名词短语）, on condition that, given（+名词）等。

下面两个例句用来说明不太常见的以 given 引出限制性条件的用法。

① Given plenty of labor, the job will be completed on schedule.

假如有充足的劳动力，这项工作将准时完成。

② Given sufficient turbulence in the combustion chamber, detonation is unlikely to occur.

假定在燃烧室中形成充分的湍流，就不可能产生爆炸。

需要指出的是，上面列出的词语均可以用于引出“真实条件句”(the open condition)，即如果或假设首先发生某一现象或事件，则可能引起另一现象或事件的发生。当假定或设想某事发生但事实上它不可能发生或者根本没有发生过时，谓语动词要用虚拟语气的结构。这种结构在科技著作中偶有出现。不过，一般来说，科技著作者不喜欢做这样的假设(hypothesis)。

（3） 表示对比、转折。对比、转折表达法是论说文的常用方法，比说明文用得更为普遍。下面再举出一些表示对比、转折的词语，以引起重视。例如，whereas, while, regardless, otherwise, despite of, alternatively, in spite of, although, though 等。

（4） 表示强调、肯定、结论和概括性的词语有 above all, clearly, without any question, certainly, undoubtedly, obviously, actually, surely, really, of course, indeed, to be sure, in fact, especially, true, essentially, practically, in practice, naturally, in effect, briefly, in short, reviewing, in summary, conclusively, to sum up, in the end 等。

（5） 表示附加说明的词语有 in addition, besides, alternatively, further, in other words, furthermore, in simple language, moreover, on the other hand, also 等。

以上列举的五类词语在科技著作中是经常见到的。事实上，从语言学角度看，这些词语起到“话语标志”(discourse markers)的作用，表示句和句之间以及比单一句更长的语言段落之间存在的意义上的关系。读者凭借这些“话语标志”可以更准确地理解科技著作的内容。

四、语法特点

科技著作在风格和结构上与文学作品截然不同，不会采用诸如隐喻、含蓄、夸张、拟人、反话以及幽默等修辞手法。科技著作者崇尚通俗、清楚、简洁和准确的风格和语言结构。因此，科技英语在语法结构上具有以下特点。

（一）动词时态种类少

由于科技著作中以说明文和论说文为主，主要说明事物的一般特性、形状、功能、发生和发展的过程，或论说一般的因果关系等，而且这些科技知识是客观事实，不受时间和地点的限制，因此用一般现在时居多。例如：

Action and reaction are opposite and equal.

On average, women live longer than men.

有时是在描述实验过程，无论谁做或在何时何地做，都会发生相同的情况，因此需要用一般现在时来叙述。例如：

The temperature rises until it reaches 100℃, but after that it remains constant.

除经常大量地使用一般现在时之外，在科技著作中有时也使用其他少数几种动词时态。例如，用一般过去时和现在完成时对事物过去的状况进行记叙或对变化后的现状进行说明。例如：

We took a zinc plate which was negatively charged. When this plate was illuminated by ultraviolet light it quickly lost its negative-charge.（记述过去的实验）

有时也需要用过去完成时表示在某种行为之前发生的事情或过去存在的状态。例如：

Before our investigation many advances had been made in the technology.

另外，由于所记述内容的需要，有时也使用进行时，一般将来时和过去将来时等。

（二）使用被动语态的句子多

据有关资料统计，在科技著作中大约有三分之一以上的句子其谓语动词使用被动语态。有些科技著作或文章绝大多数句子是被动句。究其原因，大致有下述四点：

（1） 科技著作者力求客观地对待事物，而不强调行动的主体，因此通常不用“I”“you”“the operator”等作为句子主语。例如：

Screws can be cut on a lathe.

（2） 使句意更加清楚。例如：

People heat the specimen carefully.

上句中主语 people 是谓语动词 heat 的施动者，但是这个 people 究竟是谁呢？是作者？是读者？还是其他有关人员？还是任何人？要避免这些令人迷惑的问题，可以使用下面的被动句：

The specimen is carefully heated.

（3） 把最重要的信息突出地置于句首，即主语位置，立刻吸引住读者的注意力。例如：

The characteristics of steel can be altered in various ways.

（4） 使句子更为简洁。例如：

The driver started the engine.

The engine was started.

显然，第二句被动句比第一句更加简洁。

试比较下面两段短文的特点。

We can store electrical energy in two metal plates separated by an insulating medium. We call such a device, a capacitor, or a condenser; and its ability to store electrical, energy

capacitance. We measure capacitance in farads.

我们能够把电能储存在由一绝缘介质隔开的两块金属板内。我们把这样的装置称为电容器，把其储存电能的能力称为电容。我们以法拉为单位测量电容。

Electrical energy can be stored in two plates separated by an insulating medium. Such a device is called a capacitor, or a condenser, and its ability to store electrical energy is termed capacitance. It is measured in farads.

第二段文字各句使用了被动语态，各句主语分别为 Electrical energy, Such a device, its ability to store electrical energy 和 It，四个主语完全不同，避免了反复使用代词 We，主语包含较多信息，给读者以前后连贯、自然流畅、简洁客观的感觉。

（三）名词结构多

科技文体行文简洁、内容确切、信息量大，强调客观事实，而非某一行为动作。因此，通常在普通英语中使用动词之处，科技著作者习惯于使用名词结构。试比较下面两组例句。

The filament is heated by applying a voltage.

The filament is heated by the application of a voltage.

Considerable lateral pressure is exerted by the concrete while it is being compacted.

Considerable lateral pressure is exerted by the concrete during compaction.

上面每组例句的第二句是科技英语中经常使用的典型的名词结构。使用典型的名词结构、减少句子中的动词数量，可以使概念更加明确；有些还可使原来的动词结构缩短。

在这类名词结构中，有相当数量的名词是由动词派生而来的含有动作意义的抽象名词。下面举几例以引起读者注意（见表 2）。

表 2　动词派生的抽象名词

动　　词	抽象名词	动　　词	抽象名词
classify	classification	Apply	application
combine	combination	Develop	development
achieve	achievement	maintain	maintenance
replace	replacement	equip	equipment

（四）尽量用短语代替从句或分句

科技著作中复杂的长句往往带有各种从句。为了保持语言简洁明快，科技著作者经常使用以下表达方法避免从句过多的趋向。

1. 常用分词短语和分词独立结构作状语，以代替表示时间、原因、方式、目的、结果、条件等的状语从句。例如：

The rivet contracts as it cools，drawing the plates together.（结果）

（铆钉冷却时收缩，把钢板紧固在一起。）

有时在分词前加上 thus、thereby 等副词表示强调。如上句可以写成：

The rivet contracts as it cools，thereby drawing the plates together.

（thereby 意为“因此”“从而”）

Given enough time，he could do it better.（表示时间）

从上面例中可以看出，分词短语的逻辑主语必须与句子主语一致；如果不一致，则必须在分词前加上其逻辑主语（名词或代词），构成分词独立结构。请看下面的例句：

There are many kinds of steel，each having its special uses in industry.（表示伴随情况）

（钢有多种，每种在工业上都有其特定的用途。）

从上面例句可以看出，分词短语所表达的具体状语意义有时是很含蓄的，需要细心推敲才能判断准确。

2. 用介词短语和其他短语代替从句。例如：

Before entering the nozzle，the steam is at very high pressure.

（在进入喷嘴之前，蒸汽处于高压状态。）

上句中介词短语 Before entering the nozzle 在意义上相当于 Before it enters the nozzle.

这类结构的不同情况还可以列举一些：

Prior to entering = Before it enters

When / While / In } passing through = While / As } it is passing through …

After / On } Leaving … = After it leaves

On separation … = When it is (was, …) separated …

After separation …= After it is (was, …) separated …

During manufacture = While it is (was, …) manufactured …

Before separation = Before it is (was, …) separated …

When separated = When it is (was, …) separated …

While separated = While it is (was, …) separated …

Once separated = Once it is (was, …) separated …

If separated = If it is (was, …) separated …

注意上面后四个结构中 when, while, once, if 后接过去分词，而不是名词。另外，也可以接形容词。例如：when necessary 必要时，if possible 如果可能的话，once full 一旦装满，while still hot 还热的时候。

3. 用过去分词短语代替定语从句。例如：

The steel (which is) obtained in this way is suitable for machine tools.

上面例句中省去括号中的 which be 之后，实际上缩减为过去分词短语作定语，使句子缩短。

4. 用名词作定语代替其他各种后置定语。用名词作定语的特点，在前面的词汇特点（四）中已做了介绍，这里不再举例详述。

5. 大量使用缩略词。在科技文献资料中经常使用缩略词是科技英语的一大特点。一些较为常用的缩略词往往直接引用，而不注明全称。

英语中缩略词大体上可以分为两大类：一是将一个单词缩写为词首的一个或几个字母

再加上词尾的几个字母，例如：把 engineering 缩写为“Eng”；二是把一个词组缩写为几个字母，每个字母（间或为两个以上字母）代表该词组中的一个单词（该字母为该单词的首字母），但冠词和介词全部予以省略。例如。把 light amplification by stimulated emission of radiation（受激辐射式光频放大器）缩写为“LASER”或“laser”（激光）。

应该注意，同一缩略词可能代表许多不同的词义，甚至代表同一专业的不同词义。现举例说明如下：（见表 3）。

表 3　缩略词代表不同词义举例

AA	absolute altitude	绝对高度
AA	Arithmetic average	算术平均数
AA	Assembly area	装配区
AA	Architectural Association	建筑（业）协会
AA	Automobile Association	汽车制造业协会（英）
AA	Australian Army	澳大利亚陆军
AA	American Airlines	美国航空（运输）公司
AA	acetaldehyde	[化] 乙醛
AA	acrylic acid	[化] 烯丙酸
AA	amino-acid	[化] 氨基酸

从上面的例词可以看出，在阅读科技文献遇到缩略词时，切不可想当然地理解词义，应从上下文的具体专业内容出发，查阅专业词典或缩略词词典来确定其词义。

Appendix Ⅱ The Characteristics of English Practical Writing
英语应用文的形式和特点

一、英语应用文的形式

随着时代的进步，人们的交往越来越频繁，不论是在国内还是在国外，应用文的使用越来越广泛，它的形式也越来越复杂。英语应用文的范围非常广泛，不可能一一列举说明，这里仅就机械工程类专业常用的应用文形式，如产品说明书、产品合格证及商业合同的特点做一简要说明。

（一）产品说明书

产品说明书是帮助用户认识产品、指导用户使用产品的书面材料，它对产品的结构、功能、特性、使用方法、保养、维修、注意事项等做出详细的解释说明，既介绍产品又传授知识和技能。

由于产品的种类、性质不同，对其说明方法不同，产品说明书的式样也就多种多样，但在写法上有许多共同的地方。一般说来，产品说明书大多都由标题、正文、落款三部分组成。

标题由产品名称和文种组成，例如 Miniature Electronic Calculator Operation，既说明了产品是 Calculator，又说明了是产品的操作说明书。正文分项排列所要说明的内容，并逐一解释。落款注明生产厂家名称，根据需要还可注明经营者名称。请参阅下例：

Quarts Travel Alarm Clock
Of “Three Five” Brand
Instructions
Operating Manual For
Model Q 2858 Quarts Travel Alarm Clock

Start Clock

First open the battery compartment cover, then according to the location of the battery support shown in figure, put into a new 1.5V battery.

Correcting Clock Time

Turn the alarm hand setting knob of the clock, and correct in direction indicated by arrowhead on back.

Correcting Alarm

Turn the alarm hand setting knob in direction indicated by arrowhead on back, and alarm hand will be made to turn at any desire alarm time in advance. At the same time, push up the

alarm stop knob to operating position. So when it goes to desire alarm time in advance, it will automatically give off an alarm sound enough for making you suddenly wake from sleep right now. You need only push down alarm stop knob to stop working position, that the alarm sound will be stopped immediately.

Notice:

1. This product needs to use one piece of No. 5 Battery. It will not work if you reverse the polarity of the battery.

2. When you turn hand setting knob, according to the direction indicated by arrowhead on back. Don't turn back! In order to avoid the clock work abnormally.

3. When you will be waked up by the alarm sound, please push down the alarm stop knob on time. So you can not only prevent to trouble others, but also prolong the useful life of the battery.

（二）产品合格证

产品合格证主要表示产品在出厂前经过严格的技术检验。产品合格证可以提高产品在市场上的信誉，使用户愿意购买，有的还可以起到保单的作用。产品合格证至少应该包括以下内容：产品名称、商标、型号、制造厂家名称、制造日期、检验员姓名、购买日期、出售者名称、日期及保修时间等。请参阅下例：

Lotus Flower Brand
Model 610 Radio receiver
Qualification Card

Name of Product：Radio Receiver
Brand of Product：Lotus Flower
Model：Model 610
Manufactory：Peony Radio Factory
Date of Manufacture：May 1997
Serial No：863378
Inspector：Liu Jie
Purchaser's Name：Wang Jiang
Date of Purchase：April 8, 1998
Dealer's Name：Spring Thunder Dep. Store
Dealer's Address：Wenhui Rd. 12, Xianyang City, Shanxi Province
Guarantee Period：One Year after the date of purchase

This product, manufactured of choice materials to precise standards, has undergone rigid quality control. It is fully guaranteed against defective materials or workmanship under normal use. In the guarantee period, adjustments for defects or replacement of parts will be performed free of charge upon your presentation of this qualification card.

Peony Radio Factory

Address：× × × Road, × × × City, × × × Province
Tel：× × × × × × ×

（三）商业合同

商业合同属于契约形式之一，一般是团体和团体之间、团体和个人之间、个人和个人之间就某一特殊问题经过协商取得一致意见后而拟定的一种书面凭证。合同对各方都有约束力，要求各方都履行所规定的义务，保证享受充分的权力。合同有许多类型，但格式基本相同。一份正式的商业合同通常包括标题、前言、正文、结尾、附件五部分。

1. 标题

标题常以“合同”（Agreement，Contract）为题。为使合同标题的内容更加明确，让人一目了然，可注明合同的性质或交易货物的名称。例如，Agency，Agreement。

2. 前言

前言部分一般要并列分行写明立约团体的名称（或简称“甲方 Part A、乙方 Part B”）和代表人签约日期、地点、依据及缘由。

3. 正文

正文即合同的主体，分条列出各项条款的具体内容，一般包括：

（1） 定义条款。

（2） 基本条款（主要条款，是合同的核心）。

（3） 一般条款（共性条款，法律性比较强）。

一般条款包括：

① 合同的有效期。

② 违约及索赔。

③ 合同的转让。

④ 不可抗力。

⑤ 全部协议（指合同签订后，所有在此以前有过的意向书、备忘录、协议等）都不再有效，而以该合同为准。

⑥ 依据的法律或适用的法律。

⑦ 仲裁及法院管辖。

⑧ 通知（规定通知的送达方式及由合同目的而确定的通知送达人）。

⑨ 文字（规定合同所用的文字）。

（四）结尾及附件

结尾即合同双方的签名。在合同正文以下，以双方的简称分别签署双方代表团体的名称。名称分列于左右两侧，代表的姓名要亲笔签在合同上。有的合同还要注明签约日期及正、副本份数，双方分持的份数，等等。合同根据需要可以备有附件，附件是合同不可分割的组成部分。

合同一经签署即具有法律约束力。因此，表达要求严密、具体、完整，语言必须规范，逻辑要严谨，不可有模棱两可、含糊其词的语句；各条款间要前后呼应、互相衔接，协调一致。

二、英语应用文的主要语言特点

（一）组句注重形合，用词准确、行文简洁，虚词（介词、连接词等）使用频繁。例如:

1. There are plans for new product introductions in IBM to compete with foreign companies.

IBM 公司计划拿出一些新产品与外国公司竞争。

2. The VI 3021 modern is a microcomputer-controlled device that uses two separate frequency channels for transmitted data and received data.

VI 3021 调制解调器是由微机控制的装置，它使用两个分离的频道发送和接收数据。

3. Fast answers through logical entry system.

通过逻辑进数装置即能快速求出答案。

4. Twice the performance at half the cost!

花一半的钱，却能得到双倍的性能！

5. Orders with customers' materials or samples are welcome.

欢迎来样来料加工。

6. If your order is large enough, we are prepared to reduce our prices by as much as 5 percent.

如果订货量大，我们准备降价 5%。

7. Can you give me a rough idea of the quantity you wish to order from us, so that we may adjust our price accordingly?

你能否告诉我你的订货量大约是多少，这样，我们就可以根据订货量来调整价格。

8. We trust that you will make all necessary arrangements to deliver the goods in time.

我们深信你方将做出一切必要的安排，以便货物及时发送。

9. We are looking forward with interest to your reply.

我们盼望你方赐复。

（二）为了行文便利或表示强调，句子常使用倒装结构。例如:

1. There stands a large hydroelectric power station on the river.

江上矗立着一座大型水电站。

2. Punched on the tapes are numbers of holes which mean binary's 1 for the computer.

带上打着许多孔，这些孔对计算机来说意味着二进位的 1。

3. In this design are involved a number of complicated problems which should be solved first.

这个设计涉及许多必须首先解决的复杂问题。

4. Only after a program is prepared in every detail, can the electronic computer understand the problem it to solve.

只有在十分详尽地编制出程序之后，电子计算机才能读懂要解的题目。

5. Never has a machine been so efficient and accurate as the electronic computer.

从来不曾有过像电子计算机那样效率高而又准确的机器。

6. Should the current be cut off, the coil would return to its original position.
如果切断电源，线圈即恢复到原来的位置。
7. No sooner has the current started running in one direction than back it comes again.
电流刚开始朝一个方向流动就立即返回。

（三）为行文简单，常出现“省略”形式。例如:

1. The direction (in which) a force acts is changeable.
力的作用方向是可以改变的。
2. The two forces, as shown in the figure below, are paralleled.
如下图所示，该二力是平行的。
3. A machine can never produce more work than was supplied to it.
一台机器所做的功绝不会多于供给它的功。
4. Roller and ball bearings are used whenever necessary.
一旦需要，就使用滚动轴承。
5. It is required that remote control (should) be applied to this plant.
要求将遥控应用到这一装置上。
6. Design and specifications (are) subject to change without notice.
本机外形和规格如有变更恕不另行通知。
7. In non-conductors (insulators) there are few, if any, free electrons.
在绝缘体中几乎没有自由电子，即便有，也是微乎其微。
8. The length is used in metre, the mass in kilogram, and the time in second.
长度以 m、质量以 kg、时间以 s 来表示。

Appendix Ⅲ　The Basic Knowledge of English—Chinese Translation

英汉科技翻译基础知识

不同民族使用不同的语言，为了相互间能够更好地交往、交流思想，就需要翻译。翻译是利用译文语言把另一种语言所表达的思想内容准确且完整地重新表达出来的一种语言活动。

译文应忠实于原文，准确、完整地表达原文的内容（包括原文的思想、精神和风格）。译者不得随意对原文的思想加以歪曲、删除，也不得有遗漏和篡改。译文语言必须符合规范、符合译文民族语言的习惯；要用民族的、科学的、大众的语言来表达原文的思想内容，以求通顺、畅达。这些就是翻译的一般原则。在翻译科技文章时，译文应力求逻辑正确、术语定名准确、语句简洁明确、数据无误。

因限于篇幅，本文仅以英译汉为线索，介绍翻译的基本技巧和方法。

一、词义选择

英语的词形变化相对来说比较简单，但是一词多义现象较为普遍。在科技英语中也是如此。正确地选择和确定词义是正确理解原文的基本环节。

选择词义通常可以从以下三方面着手：

（一）根据词类确定词义

以 light 为例：

Aluminum is a light metal.　铝是一种轻金属。（形容词）

Turn on the light please.　请开灯。（名词）

We light on a reference book.　我们偶然找到一本参考书。（动词）

He often travels light.　（副词）他经常轻装旅行。

（二）根据上下文中词的搭配关系确定词义

由于学科和专业不同，同一个词在不同上下文中会有不同的词义。请看下面各句中 solution 一词的译法：

The solution the mathematics teacher told you is correct.

数学老师告诉你的答案是正确的。

The chemist found that there were impurities in the solution.

那位化学家发现溶液中有杂质。

Two solutions were offered in meeting as a way out of the difficulty.

为克服这一困难在会上提出了两种解决办法。

（三）根据译文（汉语）语言搭配习惯选择词义

英语和汉语中虽然都有一词多义的现象，但搭配习惯却有很大差异。当涉及专业内容时同样如此。因此，翻译时应注意选择符合译文语言习惯的搭配，不可一律照搬词典上提供的基本词义，死译或直译。以 heavy（基本词义为“重的”）为例，请看下面的各短语的译文：

heavy rain	大雨
heavy fighting	恶战
a heavy heart	沉重的心情
heavy traffic	拥挤的交通
heavy industry	重工业
heavy current	强电流
heavy cut	强力切削
heavy lines	（图表中的）粗（黑）线

科技文章具有较强的科学性、逻辑性，词与词之间，段与段之间总是相互依存的。因此必须结合上下文推敲词义，做到词不离句，然后按译文语言——汉语的搭配习惯确定译文。请看下面的例句：

The university houses all of its students in hotels.

该大学为所有学生提供宿舍。

An aluminum bush houses the bearing.

一个铝质轴套套在轴承上。

综上所述，选择词义时应注意分清词类，从上下文联系去理解词义，从原文叙述的专业内容去判断词义，并注意语言的搭配习惯。

二、词义引申

英汉两种语言在表达方式上存在着很大差别。英译汉时，有时会遇到某些词，在词典上查不到适当的词义。如果生搬词典上某一词义逐词死译，会使译文生硬晦涩，含糊不清，不能确切表达原文的意思，甚至会造成误解，传达给读者错误的信息。这时，应根据上下文和逻辑关系以及汉语的搭配习惯，从该词的基本词义出发，引申词义，准确表达原文的思想内容和语言风格，这就是所谓“取意忘形”的意译法。

需要引申的可以是词、词组，也可以是整个句子。例如：

To make steel　炼钢。

cylindrical motion　旋转运动。

The car makes 120 kilometers an hour.　该轿车时速达 120 km。

The chief purpose of a drilling machine is to make holes.　钻床的主要用途是钻孔。

There is no physical contact between workpieces and tools. 工件与刀具不直接接触。

The light in the workshop is poor. 车间里光线不足。

Iron comes between manganese and cobalt in atomic weight. 铁的相对原子质量介于锰与钴之间。

This kind of wood works easily. 这种木材容易加工。

Other things being equal, copper heats up faster than iron. 其他条件相同时，铜比铁热得快。

The only limit on the power of human brain is the limit of what we think is possible.

人类大脑的能力恰恰是由于我们认为它有局限而被禁锢了。

（该句没有逐词死译为：人类大脑能力的限度就是我们认为其可能的那个限度。）

三、词类转译

英语和汉语在词类方面有许多相似之处，例如都有名词、动词、形容词和介词等。但是，也有不少差别。英语中有冠词、分词、动词不定式、关系代词和关系副词，汉语则没有这些词类。因此，英译汉时除了可以不译出某些词类外，有时也不一定机械地将英语某一词类译成汉语的某一词类，即把英语名词仍译为汉语名词，英语动词仍译为汉语动词，等等。这就是所谓的“词类转译”。

有些英语句子不经转译也可译成通顺的汉语，如 I am a student（我是学生）。但这毕竟是极少数。可以说绝大多数英语句子需要通过词类转换的技巧才能译成通顺的汉语。一般说来，词类转译还会伴随着句子成分的转换，二者不可能截然分开。

（一）转译成汉语名词

1. 英语代词转译成汉语名词

The switch completes the circuit when you close it.

译文 1：当你合上它时，电闸把电路接通了。

译文 2：当你合上电闸时，电闸把电路接通了。

译文 3：当你合上电闸时电路便接通了。

译文 1 没有把代词 it 译成所指代的名词，汉语不通顺，还可能造成误解。译文 2 把 it 译为名词“电闸”，是明显的改进。译文 3 巧妙地运用了汉语的意合法，最为明确简练。

Energy can neither be created nor destroyed, although its form can be changed.

虽然能量的形式可以转换，但能量既不能创造也不能消灭。

译文把原句中的代词译成“能量的”，这种译法符合汉语习惯，文字也通顺。

2. 英语动词转译成汉语名词

某些英语动词很难直接用汉语动词来表达其概念，这时可转换成汉语名词。例如：

The new boring-machine behaves well.

新镗床运转良好。

Gases differ from solids in that the former have greater compressibility than the latter.

气体和固体的区别在于前者比后者有更大的可压缩性。

The electronic computer is chiefly characterized by its accurate and rapid computation.

电子计算机的主要特点是运算准确而且迅速。

3. 英语形容词转译成汉语名词

Ships are designed to be stable, and should return to an upright position after heeling over.

船舶设计要具有稳定性，倾斜之后应能恢复到垂直位置。

Ice is not as dense as water and it therefore floats.

冰的密度比水小，因而能浮在水面上。

（二）转译成汉语动词

汉语中使用动词的频率比较高，而且也比较灵活，有时一个短句中可能用到几个动词，如他请求领导派他到最艰苦的地方去工作。其中“请求”“派”“到”“去”“工作”都是动词。而英语语法要求一个英语句子中只能有一个谓语动词，其他动词都需要以非谓语的形式出现。因此，英语中含有动词意义的名词、形容词、介词短语，以及副词有时转译为动词，更符合汉语的表达习惯。

1. 英语名词转换成汉语动词

The operation of a machine needs some knowledge of its performance.

操作机器需要了解机器的一些性能。

The pure scientist comes his attention to explanation of how and why events occur.

理论科学家把注意力集中在解释事物发展的过程和原因上。

The flow of electrons is from the negative plate to the positive.

电子由负极流向正极。

2. 英语形容词转译成动词

He is certain (that) the machine will operate well.

他确信这台机器会运转良好。

The author is grateful to his colleagues for valuable suggestions.

作者感谢同事们提供了宝贵的建议。

从上面的两例可以看出，英语中表达知觉、情感、信念、情态等的形容词作表语时往往可以转译为汉语动词。常见的这类形容词还有 confident 相信，ignorant 不知道，sure 确信，ready 准备好，afraid 恐怕，fond 喜欢，careful 注意，doubtful 怀疑，等等。

另外，英语中某些形容词与介词的固定搭配也往往可转译成汉语动词。例如：

A is similar to B in many ways.

A 在许多方面类似于 B。

常见的这类搭配有很多，如 equal to 等于，helpful to 有助于，familiar to 熟悉，relative to 和……有关，depend upon 依据，suitable for 与……相适应，short of 缺少，next to 次于，等等。

3. 英语副词转译为汉语动词

英语中作表语的副词以及作宾语补语的副词往往可以转译成汉语动词，请看下面的例句：

The sun is up. 太阳升起来了。

The experiment is over. 这项实验结束了。

That engineer took the engine apart. 那位工程师把发动机拆开了。

4. 英语介词转译成汉语动词

Machine parts at irregular shape can be washed very clean by ultrasonics.

用超声波能把形状不规则的机器零件洗得很干净。

A force is needed to move an object against inertia.

为使物体克服惯性而运动，就需要一个力。

They spoke to us about their work plan.

他们跟我们讲了关于他们的工作计划。

（三）转译成汉语形容词

1. 英语副词转译成汉语形容词

当英语形容词转译成汉语名词时，修饰该英语形容词的英语副词往往同时转译为汉语形容词。例如：

At ordinary temperature mercury is greatly stable in air.

常温下，水银在空气中具有很高的稳定性。

当英语动词转译为汉语名词时，作状语的英语副词往往可以同时转译成汉语形容词。例如：

He supposes boys think differently from girls.

他认为男孩子的思维方式和女孩子的思维方式不同。

2. 英语名词转译成汉语形容词

This experiments is a success.

这个实验很成功。

I am a perfect stranger in electric arc welding.

我对电弧焊完全陌生。

（四）转译成汉语副词

1. 英语形容词转译为汉语副词

当英语名词转译为汉语动词时，修饰该英语名词的形容词往往可以随着转译成汉语的副词。请看下面的例句：

They make a careful study of the properties of this new alloy.

他们仔细地研究了这种新型合金的特性。

Below 4℃，water is in continuous expansion instead of continuous contraction.

水在 4℃以下时，是在不断地膨胀，而不是在收缩。

2. 英语中作状语的名词或名词性词组往往可以转译为汉语副词。例如：

Theory should go hand by hand with practice.

理论应与实践密切地结合。

The compression in the cylinder of an engine must be checked from time to time.

发动机汽缸中的压缩情况，需要不时地进行检查。

在英语科普文章中这类词组较为常见，例如 year by year（逐年）、step by step（一步一步地），all the time（不断地），day and night（夜以继日地），side by side（一起），等等。

总之，词类转译现象是多种多样的，决不仅限于上述几种。同一个英语句子，由于处

理方法不同，可能有不同的转译现象。但是，其中最重要的转译是英语名词和介词转译成汉语动词，应特别注意练习。

四、句子成分的转换

由于英汉两种语言表达方式不同，语言结构形式差别很大，为了使译文符合汉语表达习惯，除了运用词类转译技巧之外，往往还伴随着句子成分的转换。例如，在某些特定的句型中，英语句子的状语、定语、表语又可能转译成汉语句子的谓语，等等。下面仅列举常见的几种情况，供举一反三、类比推敲。

（一）转换成汉语主语

1. 在英语“there be …”句型中，往往将状语略去介词转换为汉语主语。例如：

There are a variety of machine-tools in the workshop.

这个车间里有各种各样的机床。

There has been a decrease in our imports this year.

今年，我们的进口商品减少了。

注意：该句作状语的介词短语“in our imports”实际逻辑意义是说明主语“a degrease”的具体内容，因此转译成汉语译文的主语。在其他句型中有时也有类似情况。请看下面的例句：

When water freezes, it becomes larger in volume.

水结冰时，体积变大。

The machine is lighter in weight and simpler in structure.

这台机器的重量更轻，结构更简单。

另外，在科技文体中使用“there be”句型时常常译成汉语无主语句。例如：

There are a lot of scientific journals in the reading room.

阅览室里有许多科普期刊。

There are a number of methods of joining metal articles together, depending on the type of metal and the strength of the joint which is required.

把金属连接在一起有许多种方法，选用哪种方法要视金属的类型和所要求接缝的强度而定。

2. 英语被动语态句子由 by 或 in 引导的状语，往往可以转换为汉语的主语，同时略去介词不译。例如：

The Fahrenheit scale was widely used in English and USA.

英美广泛采用华氏温标。

Large quantities of steam are required by moden industry.

现代工业需要大量蒸汽。

3. 英语动词的宾语有时可以转换为汉语主语。例如：

Aluminum has a combining power of three.

铝的化合价是三。（试比较：铝有一个三的化合价）

A car battery has a voltage of 12 volt.

汽车蓄电池的电压为 12V。

4. 英语表语转换成汉语主语。例如：

Two widely used alloys of copper are brass and bronze.

黄铜和青铜是两种广泛使用的铜合金。

Of all the metals the best conductors are silver, gold and copper.

银、铜、金是金属中最好的导体。

5. 英语中介词短语作定语时，有时可以转换为汉语主语，同时略去介词不译。例如：

There are three states of matter: gas, liquid and solid.

物质有三种状态：气体、液体和固体。

（二）转换为汉语谓语

1. 英语主语转换为汉语谓语

有些英语句子的主语为含有动作意义的名词，并且后跟介词短语作定语。这种结构中介词（多为 of）宾语往往在逻辑意义上为主语名词所表达动作的宾语。因此可以把这种英语主语转换成汉语谓语。请看下面的例子：

The expression of the relation between pressure、volume and temperature as follows：

压力、体积和温度的关系可以表述如下。

Compaction of the concrete is done by vibrating machines.

用振动机压实混凝土。

2. 定语转换为汉语谓语

There is a large amount of energy wasted owing to the friction.

由于摩擦耗费了大量能量。

The two machines have the same efficiency.

这两台机器效率相同。

3. 表语转译为汉语谓语

This explanation is against the natural laws.

这种解释违反自然规律。

Vapor is always present in small amount in the air.

空气中总是含有少量蒸汽的。

（三）转换为汉语宾语

1. 英语中有大量使用被动语态的句子常常并无由 by 引出的逻辑上的主语（行为主体）。这时，句子主语往往可以转换为汉语宾语译成汉语无主语句。例如：

Work is done when an object is lifted.

举起一个物体时就做了功。

Bearings must be lubricated regularly.

必须定期润滑轴承。

2. 若使用被动语态的英语句子有由 by 引导的逻辑主语（行为主体），则往往可以转译为汉语主谓宾主动式结构，英语中的主语仍转换成汉语宾语。例如：

The steam engine was invented by Watt.

瓦特发明了蒸汽机。

The work is gripped firmly by the jaws of the chuck.

卡盘爪牢牢地夹紧工件。

（四）英语主语转换为汉语定语

1. 当英语句中及物动词（多为 have）的宾语转换为汉语主语时，则英语句中的主语同时可以转换为定语。例如：

Pigiron has poor mechanical properties.

生铁的力学性能很差。

Aluminum has poorer conductivity than copper.

铝的导电性比铜差。（试比较：铝有比铜差的导电性。）

2. 当英语句子中作表语的形容词转译为汉语名词时，则英语主语往往转译为汉语定语。例如：

Steel is much stronger than wood.

钢的强度比木材高得多。

3. 当英语句中作谓语的不及物动词转译为名词作汉语主语时，原英语句子的主语往往可以转译为汉语定语。请看下面的例句：

Steel weighs about eight times as much as water.

钢的重量约为水的八倍。

（五）英语从句的转换

1. 英语定语从句转换为汉语状语从句

英语定语从句并非在逻辑意义上都起修饰限定作用，有些定语从句有明显的状语意义。因此，翻译时必须根据上下文的逻辑关系，转换为汉语的状语从句。例如：

Electronic computers, which have many advantages, can not carry out creative work.

电子计算机虽然有很多优点，但不能进行创造性的工作。

2. 英语主句转换成汉语从句

为了符合汉语表达习惯，有时必须把英语主句译为汉语从句。例如：

One must study hard before one could succeed in mastering a foreign language.

一个人必须勤学苦练才能掌握一门外语。

3. 英语并列句译为复合句

英语中用并列连词 and, but, so, for, yet, or 等连接的并列句，大多数连词词意本身已经表示出其状语意义；而由 and 连接的并列句中，有些根据前后句的逻辑意义判断并无并列关系，也应转译出其表达的状语意义。例如：

We study English and they study Japanese.

我们学英语，而他们学日语。

Start the sound into the air, and it will make waves which you can’t see.

如果向空中发送声音，就会产生你看不见的波。

该并列句中，前句为祈使句表示条件，以 and 连接的陈述句表示由此产生的后果，因此该句应译为汉语主从复合句。

五、省译与增译

由于英语与汉语表达方式存在差异，因此英语原文与汉语译文绝不是一一对应的关系。有些词，如冠词、介词、关系代词、关系副词等，在英语中是不可缺少的，但在汉语表达时，如果逐词译出又是多余的。另外，把很多英语句子译成汉语时又需要增加一些英语原文没有的词。这种省词不译与增词加译的翻译方法，是达到准确、畅达地表达原文不可缺少的方法。

应该指出，增译不是无中生有，省译也不是恣意删减。增译的词应是英语中无其形但有其意的词，省译的词应是汉语表达时按汉语规范显得多余的词。增译与省译是否恰当，取决于译者对原文语言和译文语言掌握的熟练程度，也就是取决于译者对英语原文理解的深度和运用汉语表达的准确度。

下面介绍一些常见的情况。

（一）增译

1. 英语中含有动作意义的名词的增译

翻译英语科技文献资料时，经常遇到一些含有动作意义的名词。这时，必须根据上下文的逻辑意义，补充相关的表示动作意义的名词，以使译文更加通顺流畅。如增译“作用”“现象”“效应”“方法”“过程”“设计”“变化”“装置”等。请看下面的例句：

Considerable lateral pressure is exerted by the concrete during compaction.

在压实过程中，混凝土被施加了相当大的侧压力。

This carelessness will be his ruin.

这种粗心大意的作风会把他毁了。

这类增译的名词还可以举出一些。例如，neutralization 中和作用、oxidation 氧化作用、modification 修改方案、cycling 周期变化、working 工作条件、distribution 分布曲线等。

2. 增译概括性的词、解说性的词或使语气连贯的词

A designer must have a good foundation in statics, kinematics, dynamics and strength of materials.

一个设计人员必须在静力学、运动学、动力学和材料力学这四方面有很好的基础。

Considerable simplification in solving the above can be achieve.

在解决上述问题时，是能够达到相当大的简化的。

这类增译的名词可根据上下文的逻辑意义有所不同。例如 according to him，可以译为“按照他的观点”“按照他的理论”“按照他的方法”等，这要视上下文而定。

3. 增译英语句中省略的词

在不影响理解的前提下，为了避免重复，英语惯用法允许省略英语中的某些词语。但是，汉译时，为了使译文清楚、通顺，有时需要增译这些英语句中省去的词语。例如：

Gears must be propeerly lubricated. If (they are) not (properly lubricated), there is a large amount of energy wasted due to the friction.

齿轮必须适当润滑。如果不是这样，就会有大量能量由于摩擦而损耗掉。

The charges of nucleus and (the charges of) are equal so that the atoms is electrically

neutral.

原子核的电荷与电子的电荷相等，所以原子不带电。

以上例句中括号内的部分一般是省略不写出的，但在汉译时要增译出来。

应该说明，译成汉语时，并非所有英语句中省略的词都一定要增译出来。

This substance does not solve in water whether (it is) heated or not.

该物质无论加热与否，都不溶于水。

The records are not so good as (they are) compared with the standards.

这些记录和标准化比起来还不够好。

以上两句汉语译文中并没有增译原句括号内省略的部分，而采用了汉语意合法，仍能表达清楚而且通顺。

（二）省译

省略英语中某些词不译，是经常采用的一种翻译方法。这是因为，英语依靠介词、连词等表示前后词语或前后句之间的逻辑关系或词语关系；而汉语则多借助意合法，即从语序上做到明确上下文的逻辑关系。可见，有些英语词语可以省略不译。在翻译实践中，能否省略不译完全取决于汉语表达的需要。

1. 省略冠词

英语中冠词出现频率极高，有很多冠词只是用作名词的标记。不表示任何意义，因此可省略不译。不过，有时冠词是否存在，可使词组意义有很大差异，虽然无须译出冠词本身的意义，但必须译出整个词组意义上的差异。这一点需要特别注意。请看下面的例句：

The stability of an object is greatest when its centre of gravity is at the lowest level.

物体的重心处于最低点时，其稳定性最大。

（译文中省略了两个 the 和一个 an。不定冠词 an 是泛指某一个，句首的定冠词 the 虽为特指，但是从上下文中已经清楚了指的是什么，也不必译出；第二个定冠词 the 处在形容词最高级前面，是英语惯用法的要求，也不必译出。）

When matter changes to substance different from what it was，the change is a chemical change.

当物质变成和原来不同的物质时，这种变化叫化学变化。

该句原文中的两个不定冠词均未译出，而定冠词译为“这种”。

In the past, to fly to the moon was out of the question.

在过去，飞往月球是绝对不可能的。

In these days, to fly to the moon is out of question。

现在，飞往月球是不成问题的。

注意：在上面两个例句中 out of the question 与 out of question 意义上差别甚大，不能忽视。这类用或不用冠词引起意义上的差别的例子还有：to go to school 上学、to go to the school 去那个学校，to take place 发生、to take the place 代替，the number of the instruments 仪表的数量、a number of the instruments 一些仪表，等等。

另外，专有名词前面的 the，表示独一无二的事物，如 moon、sun 前面的 the 和形容词最高级前面的 the，都不必译出。

2. 省略介词

英语中常常用介词表达词组之间的关系，而汉语则主要借助词序和逻辑关系来表达。因此，表示时间、地点等的英语介词往往可以省略不译。例如：

Cast iron is inclined to fracture under excessive tension.

张力过大，铸铁容易断裂。（省略 under）

We have found a method for solving this problem。

我们已经找到了解决这个问题的方法。（省略 for）

3. 省略连词

为符合汉语规范，有些英语连词往往省略不译，有时还可以加译“就”“却”“再”等，使上下文语意更加明确。请看下面的例句：

Air has weight, though it is very light.

空气再轻也有重量。（省译 though）（试比较：尽管空气很轻，但它也有重量。）

A gas becomes hotter if it is compressed.

气体受压缩，温度就会升高。（省译 if）

Liquids are like solids in that they have a definite volume.

液体和固体一样，都有一定的体积。（省译从属连词 that；同时也省略了介词 in）

4. 省译代词

英语中代词比汉语用得多，有些代词在英语句型中是不可缺少的，但译成汉语时又显得累赘，因此可以省略不译。例如：

Different metals differ in their electrical conductivity.

不同金属具有不同的导电性。（省译 their）

We cannot see sound waves as they travel through air.

声波在空气中传播时是看不见的。（省译名称代词 We）

It is necessary that the bearings should be lubricated regularly.

这些轴承有必要定期加油润滑。（省译代词 It，同时也省译后面的连词 that）

5. 省译动词

英语动词的使用场合比汉语少。有时动词在英语句子中使用只是出于语法结构或惯用法的需要，没有实际词意。为了使汉语译文更加通顺、规范，在汉译时往往省略这样的动词不译。

例如：

Which machine is better?

哪台机器更好些?（省译 is）

Steels possess good hardness and high strength.

钢的硬度大，强度高。（省译 possess）

（试比较：钢具有好的硬度和高的强度。）

六、被动语态的译法

一般来说，英语中使用被动语态比汉语多。究其原因，无非出于以下几种情况：不必说出施动者；不愿说出施动者；无从说出施动者；出于上下文联系的考虑。在科技文章中，

被动语态使用范围更广，这是因为科技著作者需要客观地叙述事理，而不是强调动作的主体。汉语中很少使用被动语态，而常使用无主语句。把英语被动句译成汉语时，一般可以采用下列处理方法。

（一）译成汉语主动句

1. 译成汉语无主语句。例如：

A force is needed to stop a moving body.

要使运动着的物体停止下来，需要用力。

2. 译成“……的”“将（把）……加以……”等。例如：

Resistance is measured in Ohm.

电阻是以欧姆为单位来度量的。

This problem will be discussed tomorrow.

这个问题明天将加以讨论。

3. 增译“人们”“我们”“有人”“大家”等主语。例如：

It has been found that this machine is similar to the other one.

人们已经发现，这台机器与那台机器在结构上相似。

An interesting question was asked at the meeting.

会上，有人问了一个有趣的问题。

4. 用英语句中的介词引导的施动者作汉语句的主语。例如：

The workshop will be mechanized by us.

我们将使这个车间机械化。

Large quantities of steam are required by modern industry.

现代工业需要大量的蒸汽。

5. 将英语句中的主语转译为汉语宾语。例如：

Measures have been taken to diminished friction.

已经采取措施来减少摩擦。

Adequate heat must be supplied to melt the metal.

必须提供足够的热量，使金属熔化。

6. 将英语句中的一个适当成分译成汉语中的主语。例如：

Iron and steel are widely used in every industry.

所有工业都广泛使用钢铁。

None of this three factors should be neglected.

这三个因素一个也不能忽视。

（二）译成汉语被动句

有些英语被动句有时也可以译成汉语被动句。这时，可发挥汉语的优势，用规范的汉语忠实地表达出原文的内容。译成汉语被动句时，根据原文结构情况一般有以下两种处理方法：

1. 在汉语句谓语动词前加一助动词“被”字。例如：

The metal hardened when it was cooled in the air.

这种金属在空气中被冷却时，就硬化了。

不难看出，这种译法使译文沿用了原文的主语，而在谓语动词前加“被”字，译成与英语原文相应的被动句。

2. 用“被”“由”“受”“靠”“给”“遭”等汉语中表达被动概念的介词引导出施动者。例如：

This water is heated by the uranium fuel and is pumped to a boiler.

这种水被铀燃料加热后，由水泵送到锅炉。

Besides voltage, resistance and capacitance, an alternating current is also influenced by inductance.

除了电压、电阻和电容以外，交流电还受电感的影响。

七、英语长句的译法

（一）顺译法

英语长句的叙述层次与汉语相近时，基本上可以按英语原文的顺序依次译出。例如：

1. In the course of designing a structure, you have to take into consideration what kind of load the above mentioned structure will be subjected to, where on the structure the said load will do what is expected, and whether the load on the structure is put into position all of a sudden or applied by degrees.

（你在）设计一个构件时，必须考虑（上述）构件将承受什么样的载荷，该载荷将在构件的什么地方起什么作用，以及该载荷是突然全部施加的，还是逐渐施加的。

原文 consideration 后有三个并列的宾语从句，分别由 what、where 和 whether 引导，在第二个由 where 引导的宾语从句中又有宾语从句 what is expected，译文中没有直译为“所期望的”，而是引申译为“起什么作用”。其主要结构仍按原文顺序译出。

2. Mathematicians who try to use computer to copy the way the brain work has found that even using the latest electronic equipment they would have to build a computer which weighed over 10,000kg.

试图用计算机复制人脑活动方式的数学家们已经认识到，即使使用最先进的电子设备，也得制造一台重逾 10,000kg 的计算机才行。

原文主语 Mathematicians 后有由 who 引导的定语从句和由 which 引导的定语从句。另外，the brain works 也是定语从句，因惯用法没有关系词引导。全句主要结构仍按原文顺序译出。

（二）逆译法

有时英语长句的展开层次与汉语表达方式相反，这时就需要逆着原文的顺序译出。例如：

1. Aluminum remained unknown until the 19 century, because nowhere in the nature is it found free, owing to its always being combined with other elements, most commonly with oxygen, for which it has a strong affinity.

铝总是跟其他元素结合在一起，最普遍的是跟氧结合在一起，这是因为铝跟氧有很强

的亲和力；因为在自然界任何地方都找不到处于游离状态的铝，所以直到 19 世纪人们才知道铝。

英语表达习惯是先说出主要的，然后才说出次要的。原文主句很简单，后面 because 引出原因状语从句；其中又有由 owing to 引导的短语说明（如游离）原因；后面还有 for which 引导的定语从句，从实际逻辑意义上仍是进一步说明 most commonly with oxygen 的原因。从上面的汉语译文可以看出，除了把 for which 引导的定语从句独立译出外，主要结构与原文顺序相反。

2. A student of mathematics must become familiar with all, the signs and symbols commonly used in mathematics and bear them in mind firmly, and be well versed in the definitions, formulas as well as the technical terms in the field of mathematics, in order that he may be able to build up the foundation of the mathematical subject and master it well for pursuing advanced study.

为了打好数学基础，掌握好数学，以便学习深造，学数学的人必须掌握和牢记数学中常用的符号，精通定义、公式及术语。

该句英语原文很长，由 66 个词构成，其中 in order that 引导的目的状语从句，按汉语习惯提到译文句首。

（三）分译法

有时英语长句中各个主要概念在意义上并无密切联系，具有相对独立性；可以拆成独立的短句，再按照汉语习惯重新安排次序。为使语气连贯，有时需要增译适当的词语。例如：

1. Manufacturing processes may be classified as unit production with small quantities being made and mass production with large numbers of identical parts being produced.

制造过程可分为单件生产和大量生产。单件生产就是生产少量零件，大量生产就是大批量生产出相同零件。

英语原文中，由两个 with 引出的定语不好安排，因此采用“先译出后加以说明”的方法。

2. Radial bearings, which carry a load acting at right angles to the shaft axis, and thrust bearings, which take a load acting parallel to the direction of the shaft axis, are two main bearing used in modern machines.

承受的载荷方向与轴心线成直角的是径向轴承；承受的载荷方向与轴心线平行的是推力轴承。这是现代机器所采用的两种主要轴承。

该句英语原文的主语 radial bearings 和 thrust bearing 后分别有一非限制性定语从句，从内容看是对其先行词下定义。为使译文通顺，需要把这两个定语从句的内容先行译出，然后再译出原文主干的内容来。

3. In the last 25 of the many thousands of years which separate the discovery of electrum from the discovery of the electrons, we have at last come to realize how much the properties of the former depend on the behavior of the latter.

金银合金的发现和电子的发现已有几千年了，在最近的 25 年中，我们才认识到，金银合金的性质在相当大的程度上取决于它的电子的性质。

该句英语原文开头在由 in 引导的介词短语中，有一个 which 引导的定语从句，若作为修饰成分译成其先行词 years 的定语，则使汉语句子臃肿且不流畅，因此可采用提出先译的方法。

从以上例句不难看出，英语长句包含的语法现象比较复杂，必须在充分理解其结构的基础上，充分运用各种翻译技巧，先把拆成的短句的内容译出，然后再按汉语规范以及逻辑顺序。只有重新安排意义轻重的层次，才能使汉语译文通顺，从而准确地表达原文的内容。

Appendix Ⅳ The Mechanical Drawing in English

英文机械图纸用语

由于图面的限制，英文图纸上许多加工说明、技术条件都不是完整的句子，句中许多成分都已省略。这些图纸用语只能按照我国图纸上的习惯用法译成中文，很多情况只能是意思相符而文字不能对应。下面就几个具体问题做简要说明。

一、图纸上的标题栏

Title	Drn		Appd	
	Chd		Date	

Title	名称
Drn=Drawn by	绘图
Chd=Checked by	校对
Appd=Approved by	审核
Date	日期

二、图纸上的明细栏

3				
2				
1				
Part No.	Detail ref.	Name of part	Material	No. off
Scale		Projection	Drg. No.	
Finish		Name of Firm		

Part No. = Part number	零件序号
Detail ref. = Detail reference	零件图号
Name of part	零件名称
Material	材料
No. off = Number off	件数
Scale	比例

Projection	视图
Drg. no =Drawing number	图号
Finish	表面粗糙度
Name of Firm	公司名称

三、其他常见符号及图纸用语

3- ϕ10 mm^{2}holes equally speed	3 个 ϕ10 平方毫米均布
2- ϕ6 drill with pc. #127 at assembly	2 个 ϕ6 平方毫米与#127 件配钻
1/8 inch sawcut	锯缝 1/8 英寸（1 英寸=25.4mm）（宽）
2 req'd (required)	需用两件
2-M10 holes taped with #153 at assembly	2 个 M10 与#153 件钻攻螺纹
4- ϕ10 drill spotface ϕ16 mm^2 × 2mm deep	钻 4- ϕ10，锪孔 ϕ16 平方毫米深 2 毫米
40- ϕ8 mm^{2}holes each 20 mm apart	钻 40- ϕ8 平方毫米，孔距 20 毫米
Bill of material	材料明细表
B-view	B 向视图
Cadmium(chromium，nickle) plating	镀镉（铬、镍）
Case –hardened to 40～45 HRC	表面淬火至 40～45 HRC
Chamfer both ends	两端倒角
Concentricity of ϕA in reference to ϕB to be within 0.02 mm	ϕA 对 ϕB 的同轴度允差为 0.02 毫米
C'bore(=counterbore)	（锪）平坑
C'sink(=countersink)	（锪）沉头孔
Crown to 1/32 inch	（轮面车出）凸起 1/32 英寸
Dispatch No.	出厂号
Drawn to 250～300 HBS	回火到 250～300 HBS
Elevation	正视图
Finish Ra0.32μm unless otherwise specified	其余 Ra0.32μm
F.a.o (Finish all over)	全部加工
Inclination 1:100	斜度 1:100
Knurl	滚花
Legend	图例
Misalignment to be within 0.05	同轴度误差不超过 0.05
Neck 1/8 inch × 1/16 inch	退刀槽 1/8 英寸宽 × 1/16 英寸深
To be normalized	须正火
Notes (or Remarks)	附注

（续表）

Oil groove 1/8 inch × 1/16 inch	油槽 1/8 英寸宽 × 1/16 英寸深
Optional parts	非标准件
Ovality of ϕ25 mm^2 B4 to be within 0.05 mm	ϕ25 平方毫米 B4 的圆度误差不超过 0.05 毫米
Pickled after peening (sand blast)	抛丸（喷砂）后酸洗
Psc rio. (piece no.)	件
Peen end of hand in position	手柄端部铆接固定
Plan	平面图
Polish to mirror finish	镜面抛光
Quench and tempered to 250～300 HBS	调质到 250～300 HBS
Rounds R5 unless otherwise noted	未注圆角 R5
Ream ϕ20 mm^2 for dowel pin	铰 ϕ20 平方毫米定位销钉
Runout of ϕA in reference to $\phi$to be within 0.05 mm	ϕA 对轴线的径向跳动误差不超过 0.05 毫米
Section *A-A*	*A-A*（截面）
Serial No.	（机器）序号
Spot for set screw with pc. #1003 in position	与#1003 件配钻，并锪出定位螺钉浅窝
Superseded by drawing No. 1135-A	本图纸作废，由 1135-A 号图代替
Symmetrical position of slot in reference to ϕ to be within 0.05 mm	槽对中心线的对称度误差不超过 0.05 毫米
Tap 4-M10 holes, equally spaced on ϕ	攻螺纹 4-M10，各孔沿中心线均布
Taper 1:20	锥度 1:20
Taper to be within 0.05 mm	锥度不超过 0.05 毫米
Technical specification(Tech. Sp.)	技术标准
Technical requirement(Tech. Req’t)	技术要求

注：表中有个别用语的单位是英寸（已在表中注明）。这是英文习惯用法。1 英寸=25.4mm。

Appendix Ⅴ　Glossary

总词汇表

A

abnormal [æb'nɔ:məl]	*a.* 异常的；反常的
accommodate [ə'kɔmədeit]	*v.*（使）适应
accumulate [ə'kju:mjuleit]	*v.* 堆积；积累
accuracy ['ækjərəsi]	*n.* 精确（性）；准确（性）
acid cleaner	酸洗液
acronym ['ækrənim]	*n.* 词头，只取首字母的缩略词
act as	作为
actuator ['æktjueitə]	*n.* 油缸，汽缸；执行机构；传动装置
advent ['ædvənt]	*n.* 出现；到来
agency ['eidʒənsi]	*n.* 代理处；代理权
aggregate ['ægrigət]	*n.* 合计；聚集；*a.* 合计的；聚集的
agree with	同意
align [a'lain]	*vt.* 使成一直线；校正
alignment [ə'lainmənt]	*n.* 对准；成直线；同轴度
allow for	考虑到；估计
alter [ɔ:ltə]	*vt.* 改变，改动
amplifier ['æmplifaiə(r)]	*n.* 放大器
a myriad of	无数的，各种各样的
analyze ['ænəlaiz]	*vt.* 分析；分解
angle ['æŋgl]	*n.* 角；角度
animate ['ænimeit]	*vt.* 使有生气；使活泼；　*a.* 栩栩如生的
anneal [ə'ni:l]	*vt.* 退火
anticlockwise ['ænti,klɔkwaiz]	*a.* 逆时针的
appendages [ə'pendidʒiz]	*n.* 附属物；附件
apply [ə'plai]	*vt.* 应用；施加

appropriation [əˌprəupriˈeiʃən]	*n.* 据为己有；占有；拨款
arbitration [ˌɑ:biˈtreiʃn]	*n.* 仲裁
arc [ɑ:k]	*n.* 电弧；弧
arc welding	电弧焊
architecture [ˈɑ:kitektʃə]	*n.* 体系结构；建筑学；建筑风格
are distinguished by	区别于
arise from	由……而产生；起因于
armature [ˈɑ:mətʃə(r)]	*n.* 电枢
assembly [əˈsembli]	*n.* 总成，组件
assume [əˈsju:m]	*vt.* 呈（某形式）；假定；承担；接受
as well as	也，又
atmosphere [ˈætməsfiə]	*n.* 大气（压）；气氛；环境
attempt to (+inf.)	试图，企图
attractive [əˈtræktiv]	*a.* 吸引人的，有魅力的
attribute M to N	认为 M 是由 N 引起的
audiovisual [ˈɔːdjəuˈviʒuə1]	*n.* 视听设备
automate [ˈɔ:təmeit]	*vt.* 使自动化
automatic tool changers	自动换刀架
available [əˈveiləbl]	*a.* 可用的；可得到的
award [əˈwɔ:d]	*vt.* 授予；奖给；判给
axis [ˈæksis]	*n.* 轴线；轴心

B

background [ˈbækgraund]	*n.* 背景，后台
backlash [ˈbæklæʃ]	*n.* 侧向间隙；后退
backup battery	备用电池
balance [ˈbæləns]	*n.* 平衡； *vt.* 使平衡
bed [bed]	*n.* 床；床身
be available	可利用的
be defined as…	被定义为……
be directly proportional to	与……成正比
be equipped with	装备……
be exposed to	招致，遭受；曝露在
be familiar with	熟悉
be known as	被称为

be subtracted from 从……减去
be population for…application 在……应用很广泛
be poured into 浇入，注入
be responsible for 负责
bead [biːd] *n.* 水珠；[机] 卷边；车轮圆缘；加强筋
bear an resemblance to 与……有相似之处
bed [bed] *n.* 床；床身
behavior [biˈheivjə] *n.* 行为；举止；表现；性质；状态
Belleville springs 蝶形弹簧（贝氏弹簧）
bilateral [baiˈlætərəl] *a.* 双向的
bismuth [ˈbizməθ] *n.* 铋
boundary [ˈbaundəri] *n.* 界线；范围
box jig 箱式钻模；固定式钻模
braze [breiz] *vt.* & *n.* 铜焊；硬钎焊
brazing [ˈbreiziŋ] *n.* 铜焊；硬钎焊
breed [briːd] *n.* 品种，种类
brittle [britl] *a.* 碎的；易碎的
broaching machine 拉床
buffer [ˈbʌfə(r)] *n.* 缓冲器；减震器；　*vt.* 缓冲，减轻
bump [bʌmp] *vt.* & *vi.* 撞倒；冲撞；　*n.* 碰撞，猛撞
bushing [ˈbuʃiŋ] *n.* 钻套，衬套

C

cadmium [ˈkædmiəm] *n.* 镉
calculate [ˈkælkjuleit] *vt.* & *vi.* 计算，估计；打算，旨在
cam [kæm] *n.* 凸轮
cantilever-spring 悬臂式（汽车）弹簧
capability [ˌkeipəˈbiləti] *n.* 性能；耐受力
capacitor [kəˈ pæsitə] *n.* 电容器
capacity [kəˈpæsiti] *n.* 容量，容积；才能，能力
carbide [ˈkaːbaid] *n.* 碳化物
carbon [ˈkaːbən] *n.* 碳
carriage [ˈkæridʒ] *n.* 溜板；拖板
carry out 进行；执行；完成
casting [ˈkaːstiŋ] *n.* 铸件；铸造

category ['kætigəri]	*n.* 分类；种类
cease [si:s]	*v.* 停止，结束；*n.* 停息
cement [si'ment]	*vt.* 黏接；*n.* 水泥
cementite [si'mentait]	*n.* 渗碳体；碳化铁
changeover [ʧein(d)dʒ əuvə(r)]	*n.* 转换
charge [tʃɑ:dʒ]	*n.* & *v.* 电荷；充电
chip [tʃip]	*n.* 片，板；切屑
chip conveyor	排屑输送机
chuck [tʃʌk]	*n.* 卡盘；用（卡盘）夹紧
circularity [sə:kju'læriti]	*n.* 圆度
cite [sait]	*vt.* 引用；引证
clamp [klæmp]	*n.* 夹具体；　*vt.* 夹紧
clearance ['kliərəns]	*n.* （公差中的）间隙，距离，容积
clutch [klʌtʃ]	*n.* 离合器
coat [kəut]	*vt.* 涂上
coin [kɔin]	*vt.* 创造
coil [kɔil]	*n.* 线圈
come in contact with	同……接触
comic ['kɔmik]	*n.* 连环漫画；喜剧的
command [kə'mɑ:nd]	*n.* 命令；　*vt.* & *vi.* 指挥；控制
commercially [kə'mə: ʃəli]	*ad.* 商业上；工业上
commission [kə'miʃən]	*n.* 授权，委托；委员会；佣金，回扣
commodity [kə'mɔditi]	*n.* 商品；货物
communication [kəˌmju:ni'keiʃən]	*n.* 交流；交际；通信
community [kəˈmju:nəti]	*n.* 社区；共同体；社会团体
compatible kəm'pætəbl]	*a.* 兼容的，可匹配的
component [kəm'pəunənt]	*n.* 成分，组成部分；部件，元件
comprehend ['kɔmpri'hend]	*vt.* 理解，了解
comprehensive [ˌkɔmpri'hensiv]	*a.* 广泛的；综合的
compression [kəm'preʃən]	*n.* 压缩
compressive [kəm'presiv]	*a.* 有压力的；有压缩力的
computation [ˌkɔmpju'teiʃən]	*n.* 计算；估计；计算法；测定
computer integrated manufacturing system (CIMS)	计算机集成制造系统
concentricity [ˌkɔnsən'trisəti]	*n.* 同轴度

concession [kən'seʃən] *n.* 承认；允许；妥协，让步；特许权
concretely ['kɔnkri:tli] *ad.* 具体地
conductor [kən'dʌktə(r)] *n.* 导体
configuration [kənˌfigə'reiʃn] *n.* 配置；构造
confine [kən'fain] *vt.* 限制；局限于； *n.* 界限，范围
construct [kən'strʌkt] *vt.* 修建，建立；构成，组成
contact ['kɔntækt] *n.* & *vt.*（使）接触
contract ['kɔntrækt] *vt.* & *vi.* 缔结；订契约； *n.* 契约，合同
contrary ['kɔntrəri] *a.* 相反的，相违的
conversion [kən'və:ʃn] *n.* 变换；转化
convert [kən'və:t] *vt.* & *vi.*（使）转变，（使）转化
convey [kən'vei] *vt.* 运输，运送；表达，转达
conveyor [kən'veiə] *n.* 搬运者；传达者；输送机
coolant ['ku:lənt] *n.* 切削液；乳化液；冷却剂
cooperation [kəuˌɔpə'reiʃən] *n.* 合作
cope [kəup] *n.* 上箱
copying miller 仿形铣床
corporation [kəuˌɔpə'reiʃən] *n.* 公司，社团
counter ['kauntə] *n.* 计数器
counterbalance ['kauntəˌbæləns] *n.* 平衡
coupling [kʌpliŋ] *n.* 联轴器；连接
crane [krein] *n.* 起重机，吊车，升降架，升降设备
crankshaft ['kræŋkʃɑ:ft] *n.* 机轴；曲轴，曲柄轴
crash into 撞上；闯入
crisp [krisp] *a.* 脆的，鲜脆的
criterion [krai'tiəriən] *n.* 依据，准则
critical ['kritikəl] *a.* 决定性的，危急的；批评的，批判的
crosshatching ['krɔshætʃiŋ] *n.* 交叉排线（法）；十字晕；双向影线
crucial ['kru: ʃəl] *a.* 决定性的；紧要关头的
Cst = Centistoke ['sentistəuk] *n.* 厘斯（动力黏度单位，1Cst=1mm^2）
curve [kə:v] *n.* 曲线；弯曲； *vt.* 使弯曲
custom-built 客户定制
cut off 切掉，切断；关掉
cutter [kʌtə] *n.* （切削）刀具
cylinder ['silində] *n.* 液压缸

D

damper ['dæmpə]	*n.* 阻尼器，减震器；起抑制作用的因素
dash [dæʃ]	*v.* 划线
dashed line	虚线
dead center	尾架顶尖
debris ['debriː]	*n.* 废墟，残骸
debug [ˌdiː'bʌg]	*vt.* 调试
decelerate [ˌdiː'seləreit]	*vt.* & *vi.*（使）减速；降低速度，减速；慢化；制动
decode [diː'kəud]	*vt.* 译（码），解（码）
decoder [diː'kəudə]	*n.* 译码器
define [di'fain]	*vt.* 解释，给……下定义
deflection [di'flekʃən]	*n.* （尤指击中某物后）突然转向；偏斜，偏离
delivery [di'livəri]	*n.* 递送；交付
denote [di'nəut]	*vt.* 指示，表示
depend on	依靠
deputy ['depjuti]	*n.* 副手；代理人，代表
deputy-headmaster	副校长
descriptive [dis'kriptiv]	*a.* 描述的
detachable [di'tætʃəbl]	*a.* 可分开的，可分离的
detect [di'tekt]	*vt.* 发现，找到；侦察，探测
determine [di'təːmin]	*vt.* 决定；确定
deviation [ˌdiːvi'eiʃən]	*n.* 偏差，误差
diamond ['daiəmənd]	*n.* 金刚石
differential [ˌdifə'renʃəl]	*n.* 差异
dimension [dai'menʃn]	*n.* 尺寸；维，度；量纲
dielectric [daii'lektrik]	*n.* 电介质
diode [‘daiəud]	*n.* 二极管
direct [di'rekt]	*a.* 正面的，正向的； *vt.* 指导，支配
disbursement [dis'bəːsmənt]	*n.* 支付款，支出额
discarding battery	丢弃的电池
discipline ['disəplin]	*n.* 纪律；学科
discrete [dis'kriːt]	*a.* 离散的
disengage [ˌdisin'geidʒ]	*vt.* 脱开，分离；解脱

dispatch [dis'pætʃ] *vt.* 派遣；快速处理
displacement [dis'pleismənt] *n.* 排液量
disposition [ˌdispə'ziʃən] *n.* 安排；布置；支配；处理权
dissipate ['disipeit] *vt.* & *vi.* 驱散；消失； *vt.* 浪费
distinguished [dis'tiŋgwiʃt] *a.* 卓越的；著名的；受人尊敬的
disturbance [di'stəːbəns] *n.* 动乱；干扰；侵犯
double throw switch 双掷开关
double-pole 双极（刀开关）
double-pole single throw 双极单掷开关
dowel ['dauəl] *n.* 定位销，销钉
downstream [ˌdaun'striːm] *a.* 下游的
draft [drɑːft] *n.* 草稿，草案，草图；汇票
drag [dræg] *n.* 下箱； *v.* 拖，拉
drawing ['drɔːiŋ] *n.* 图
drill [dril] *n.* 钻头； *vt.* 钻（孔）
drilling ['driliŋ] *n.* 钻削
dry run 空运行
dullness [dʌl'nəs] *n.* 钝化
duly ['dju:li] *ad.* 正确地，适当地；按时地，准时地
duplicate ['dju:plikit] *n.* 复制品； *a.* 复制的； *vt.* 复制
dwell [dwel] *vi.* 留居；居住，停留于
dyestuff ['daistʌf] *n.* 染料

E

efficient [i'fiʃənt] *n.* 效率；功效
efficiently [i'fiʃəntli] *ad.* 有效率地，有效地
elastic [i'læstik] *a.* 弹性的，有弹力的
electrode [i'lektrəud] *n.* 电极
electromechanical 机电的
electromechanical control 机电控制
electromechanical Department 机电系
electronic [ilek'trɔnik] *a.* 电子的
electronic governor 电子调速器
electronic pathway 电子线路
element ['elimənt] *n.* 元件

eliminate [i'limineit] *vt.* 消除，排除；切断，分离
elliptical type spring 椭圆形弹簧
embrittle [im'britəl] *v.* 使变脆
emerge [i 'mə:dʒ] *vi.* 出现；形成
encoder [in'kəudə] *n.* 编码器
encompass [in'kʌmpəs] *v.* 包含或包括某事物
enhance [inˈhɑ:ns] *vt.* 加强，提高，增加
enterprise ['entəpraiz] *n.* 事业，计划；企[事] 业单位，公司
enunciate [i'nʌnsieit] *vt.*（清晰地）发音；确切地说明
environment [in'vaiərənmənt] *n.* 环境；围绕；周围状况
equipment [i'kwipmənt] *n.* 设备；装备；配备；技能
essence [ˈesns] *n.* 本质，实质；精华，精髓
establish [is'tæbliʃ] *vt.* 建立，成立；安置
explosion [ik'spləuʒn] *n.* 爆炸；爆发；激增，扩大
evaporate [i'væpəreit] *v.*（使）蒸发
evolve ['ivɔlv] *vt.*（使）逐渐形成
except that 除……之外
exclusive [iks'klu:siv] *a.* 专用的；独家的
execute ['eksikju:t] *vt.* 执行；实现；使生效
execution [ˌeksi'kju: ʃn] *n.* 实行，执行
exhibition [ˌeksi'biʃən] *n.* 展览，展览会
extensive [iks'tensiv] *a.* 广泛的，广大的
external [ik'stə:nl] *a.* 外面的，外部的；外观的，表面的

F

fabric ['fæbrik] *n.* 织物
fabricate ['fæbrikeit] *vt.* 制作；装配；组合
facet ['fæsit] *n.*（宝石或首饰的）小平面，面
facing sand 复面砂
fasten ['fa:sən] *vi.* 固定，紧固
face-helical 平面螺纹
fastening ['fa:sniŋ] *n.* 紧固件
fatigue strength 疲劳强度
feasible ['fi:zəbl] *a.* 可实行的；合理的
feat [fi:t] *n.* 功绩； *a.* 合适的，合身的（衣服）

feature ['fiːtʃə(r)] *n.* 特色
feed [fiːd] *vt.* & *n.* 进给，送给
feeder ['fiːdə] *n.* 冒口；送料器
feedrate ['fi:d reit] *n.* 进给速率
ferrite ['ferait] *n.* 铁素体
fiction ['fikʃən] *n.* 虚构；杜撰
filament ['filəmənt] *n.* 细丝；灯丝
filter out 过滤
Financial Bureau 财政局
finite element analysis(FEA) 有限元分析
flatness ['fl'ætnis] *n.* 平面，平面度
flexible ['fleksəbl] *a.* 易弯的
flexible manufacturing system(FMS) 灵活性制造系统
flip [flip] *vt.* 使翻转；掷
flowrate ['fləureit] *n.* 流量
fluctuation [ˌflʌktju'eiʃən] *n.* 变化；波动
flush [flʌʃ] *a.* 齐平的； *ad.* 齐平地； *vt.* 使齐平
flux [flʌks] *n.* 助熔剂，焊剂；流量；流出；溶解
flywheel ['flaiwiːl] *n.* 飞轮
forge [fɔːdʒ] *vt.* 锻造； *n.* 锻造车间；铁匠铺；熔铁炉
four-jaw independent chuck 四爪独立卡盘
frequence ['friːkəns] *n.* 频率
frictional ['frikʃənəl] *a.* 摩擦的

G

gear [giə(r)] *n.* 齿轮；传动装置
geometry [dʒi'ɔmitri] *n.* 几何（学）
go unexplored 不被利用的
governor ['gʌvənə(r)] *n.* 操纵杆，控制器
granite ['grænit] *n.* 花岗岩，花岗石
guarantee [ˌgærən'tiː] *vt.* 保证；担保； *n.* 保证，保障；保证书；保用期

H

hall [hɔːl] *n.* 门厅

hardcopy [hɑ:dkɔpi]	*n.* 硬拷贝
hardware ['hɑ:dwɛə]	*n.* 零件，附件，硬件
head-stock ['hedstɔk]	*n.* 头架；车床头；主轴箱；车头箱
helical ['helikəl]	*a.* 螺旋状的；螺旋线
hence [hens]	*ad.* 然而，因此
hereafter [hiər'ɑ:ftə(r)]	*ad.* 今后，从此以后
hereby ['hiə'bai]	*ad.*（用于公文件中的）以此方式；特此
hitch [hitʃ]	*n.* 故障
hollow ['hɔləu]	*a.* 空心的； *n.* 洞
honing ['həuniŋ]	*n.* 珩磨
Hooke's law	虎克定律
hydraulic turbine	胡力透平机
hypeeutectoid [ˌhaip ju:'tektɔid]	*a.* 亚共析（的），亚共析体

I

identify [ai'dentifai]	*v.* 识别
imbed [im'bed]	*vt.* 埋置；把……嵌入
impact ['impækt]	*n.* 冲击，碰撞
impeller [im'pelə]	*n.* 叶轮；转子
implication[ˌimpli'keiʃn]	*n.* 含义，言外之意
in a canned cycle	在一个封闭的循环期内
in accordance with	按照
in case	万一
in depth ['in'depθ]	*ad.* 深入地，彻底地
in direct proportion to	与……成正比
in the main	主要，大体上，总的来说
in-1ine	在线；在管线内
inactive [in'æktiv]	*a.* 不活动的，不活跃的，停止的
inanimate [in'ænimət]	*a.* 无生命的；无精打采的；单调的
incorporate [in'kɔ:pəreit]	*vt.*结合；使混合
indent [in'dent]	*vt.* 订货，（向……）正式申请； *n.* 合同，国外订货单
index ['indeks]	*n.* 索引；标志，象征；量度； *vt.* 给…编索引，指示出
indexing ['indeksiŋ]	*n.* 分度法；指标

indexing jig	回转式钻模
indicate [indi'keit]	*vt.* 指向
indicator [indi'keitə]	*n.* 指示物，指示器
indispensable [ˌindis'pensəbl]	*a.* 不可缺少的，必需的
individual [ˌindi'vidjuəl]	*a.* 独立的，个别的
Industrial Fair	工业博览会
inert [i'nə:t]	*a.* 惰性的
inflame [in'fleim]	*v.* （使）燃烧
ingress ['ingres]	*n.* 进入
inherently [in'hiərəntli]	*ad.* 天生地，本质地
in-process gauging	在线检测
installation [ˌinstə'leiʃən]	*n.* 安装；设置；就职；装置；设备
installment [in'stɔ:lmənt]	*n.* 部分；分期付款
instant ['instənt]	*a.* 立即的；直接的
institute ['institju:t]	*vt.* 建立；制定；　*n.* 协会，学会；学院
insulator ['insjuleitə(r)]	*n.* 绝缘体
integration [ˌintiˈgreiʃn]	*n.* 整合；一体化
intent [inˈtent]	*n.* 目的，意图
interchange [ˌintə'tʃeindʒ]	*vt.* 交换
interface ['intəfeis]	*n.* 接口；界面
interference [ˌintə'fiərəns]	*n.* 干扰；干涉，阻碍
interference-free	无干扰
interior [in'tiəriə]	*n.* & *a.* 内部（的）
intermediate [ˌintə'mi:djət]	*a.* 中间的；中级的
internally [in'tənəli]	*ad.* 内部
invade [in'veid]	*vt.* 拥入，占领
in the realm of	在……领域里
inventory ['invəntəri]	*n.* 财产等的清单，详细目录，存货清单； *vt.* 把……编入目录
invest in	投入
investment [in'vestmənt]	*n.* 投资
invoice ['invɔis]	*vt.* 开……的发票
is consists of	由……组成
is mounted on	安装在

J

jaw [dʒɔː]	*n.* 卡爪；虎钳牙
jig [dʒig]	*n.* 夹具；钻模
jog feedrate override	点动进给倍率
join [dʒɔin]	*vt.* 连接，结合
joint [dʒɔint]	*n.* 接缝；接合处
joint-hinged	铰[链] 接合，铰[链] 接头
just about	几乎

K

key [kiː]	*n.* 键，钥匙

L

labor cost	劳动力成本
lathe [leið]	*n.* 车床
lead time	交货时间，交货期；生产周期
leaflet ['liːflit]	*n.* 传单，散页印刷品
leakage ['liːkidʒ]	*n.* 泄漏
legible ['ledʒəbl]	*adj.* 清晰的；易读的
level [liːvə(r)]	*n.* 杠杆
level switch	（信号）液位开关
linear ['liniə(r)]	*a.* 线性的，直线的
linkage ['liŋkidʒ]	*n.* 连接；结合；联系；联动装置
literally ['litərəli]	*ad.* 严格地；字面上地
lithium ['liθiəm]	*n.* 锂
live center	主轴顶尖
load [ləud]	*vt.* 装载；负荷，负载
locating [ləu'keitiŋ]	*n.* 定位（法）
look around	四下观望，进行调查
loosen ['luːsən]	*vt.* & *vi.* 解开；放松；松开；松弛
lubricating oil	润滑油
lubricity [ljuː'brisiti]	*n.* 润滑性能

M

machine centers	加工中心
machine tool	机床；工具机
machinist [məʃiːnist]	*n.* 机械师；机械工人
magnitude ['mægnitju:d]	*n.* 大小，积，量，长（度）；巨大；重要性
magazine [ˌmægə' zi:n]	*n.* 刀库；自动储存送料装置；杂志，期刊
magnetic field	磁场
magnify [‘mægnifai]	*v.* 放大
maintain [mein'tein]	*vt.* 保持；继续；保养，维护；坚持；主张
maintenance ['meintənəns]	*n.* 维护，保持
manipulator [mə'nipjuleitə(r)]	*n.* 操作者；操纵者；操纵器
manual ['mænjuəl]	*a.* 用手的，手工的；*n.* 手册，指南
manuscript ['mænjuskript]	*n.* 手稿，原稿，底稿
marriage [ˈmæridʒ]	*n.* 密切结合；合并
martensite ['mɑ:tənzait]	*n.* 马氏体
mate [meit]	*v.* & *n.* 配合；配成对；配对物
mechanical and electronic engineering	机电工程
mechanical [mə'kænikl]	*a.* 机械的；机械学的
mechanism [ˈmekənizəm]	*n.* 机械结构；机械装置
mechatronics [mekətrəniks]	*n.* 机电一体化；机械电子学
memorandum [ˌmemə'rændəm]	*n.*（备忘的）记录；非正式商业书信，便函
memory ['meməri]	*n.* 存储；存储器；记忆装置
merely ['miəli]	*ad.* 仅仅，只不过
metallic [mi'tælik]	*a.* 金属的
metalwork ['metlwəːk]	*n.* 金属加工（制造）
metrologist ['metrəuləudʒist]	*n.* 计量师
metrology [mə'trələdʒi]	*n.* 计量学；计量制
microcomputer ['maikrəukəm'pjuːtə(r)]	*n.* 微机
micrometer [mai'krɔmitə(r)]	*n.* 测微器；千分尺
microprocessor ['maikrəu'prəusesə(r)]	*n.* 微处理器
microstructure ['maikrəu'strʌktʃə]	*n.* 显微结构
mill [mil]	*n.* 铣刀，铣床，铣
milliamp (mA) [mili'æmp]	*n.* 毫安（mA）
milling ['miliŋ]	*n.* 铣（削），铣削法；铣出的齿边

milling machine 铣床
minus ['mainəs] *a.* 负的；减去的； *n.* 负量；负号
mobile phone 移动电话
modify ['mɔdifai] *vt.* 修改
molybdenum [mə'libdinəm] *n.* 钼
molybdenum wire 钼丝
monitor ['mɔnitə] *n.* 监视器；检测器； *vt.* 监视；检测
mould [məuld] *n.* 模型，铸型，压模
moulding box 砂箱
multidisciplinary [ˌmʌltidisə'plinəri] *a.* 多学科的，包括各种学科的
multifarious [ˌmʌlti'feəriəs] *a.* 许多的，多方面的；各式各样的
multimedia [ˌmʌlti'miːdjə] *n.* 多媒体
multimeter ['mʌlti ˌmiːtə] *n.* 万用表
municipal [mjuː'nisipl] *a.* 市的；市政的
mutual ['mjuːtʃuəl] *a.* 相互的，彼此的；共同的，共有的
myriad ['miriəd] *n.* & *a.* 无数，极大数量；多种的，各式各样的

N

negative ['negətiv] *n.* 负极
negotiation [niˌgəuʃi'eiʃən] *n.* 协商；谈判
nominal ['nɔminəl] *a.* 公称的；名义上的
non-elastic 非弹性的
notation [nəu'teiʃən] *n.* 符号；标志
nozzle ['nɔzl] *n.* 管嘴，喷嘴

O

off-load 卸荷
ohm [əum] *n.* 欧姆
opportunity ['ɔpə'tjuːniti] *n.* 机会
option ['ɔpʃən] *n.* 选项
ordinance ['ɔːdinəns] *n.* [正] 条例，法令
orifice ['ɔrifis] *n.* 节流孔，小孔
original [ə'ridʒinəl] *a.* 最初的，原始的
oscillator ['ɔsileitə] *n.* 振荡器
overheat [ˌəuvə'hiːt] *vt* 过热

overlap [ˌəuvəˈlæp] *v.* 重叠；相交；（部分）一致

overload [ˌəuvəˈləud] *n.* 过载

oxidation [ˌɔksiˈdeiʃən] *n.* 氧化

oxide coating 氧化膜

P

package [ˈpækidʒ] *v.* 封装

pad [pæd] *n.* 垫片

pallet [ˈpælit] *n.* 棘爪；货盘

parity [ˈpæriti] *n.* 同等；对等；奇偶性

parting operation 分离操作

parting sand 分型砂

patent [ˈpeitənt] *n.* 专利（权）

pattern [ˈpætən] *n.* 模型；样品；图案

pearlite [ˈpə:lait] *n.* 珠光体

perform [pəˈfɔ:m] *vt.* & *vi.* 执行；履行

performance [pəˈfɔ:məns] *n.* 履行；执行；性能；工作情况

permanent [ˈpəːmənənt] *a.* 永久的；固定的；恒定的

perpendicularity [ˌpəˌpəndikjuˈlærəti] *n.* 垂直度

pertaining to 适合

pick up 探测出

pin [pin] *n.* 销，钉

piping [ˈpaipiŋ] *n.* 管道

plastic [ˈplɑ:stik] *a.* 可塑的；塑性的，塑料的

plate jig 盖板式钻模；平板式夹具

plotter [ˈplɔtə] *n.* 描绘器；图形显示器；绘图器

plus [plʌs] *a.* 正的；略大的；正量

pneumatic [nju: ˈmætik] *a.* 气动的；空气的

pneumatic control 气动控制

pocket [ˈpɔkit] *n.* 袋，口袋； *vt.* 把……装入袋内； *a.* 袖珍的；小型的

portion [ˈpɔ:ʃən] *n.* 部分；段

positive [ˈpɔzətiv] *n.* 正极

potentiometer [pəˌtenʃiˈɔmitə(r)] *n.* 电位计；分压计

power shift gear 动力滑移齿轮

power-transmission-element	传递动力的零件
precede [ˌpri'si:d]	*vt.* & *vi* （时间，位置，次序）在……之先[前]，领先于，在……之上；比……重要；在……前加上；为…加上引言（by，with）
precision [pri'siʒən]	*n.* 精确度；准确（性）
predict [pri'dikt]	*v.* 预言；预测；预示；预告
prefix ['pri:fiks]	*n.*〈语〉前缀
preservation [ˌprezə'veiʃən]	*n.* 保存，保藏，储藏，保持
pressure relay	压力继电器
pretension [pri'tenʃən]	*n.* 预拉伸；预应力
primarily [prai'merəli]	*ad.* 首要地，主要地
printed circuit board (PCB)	印制电路板
process annealing	工序间退火
product quality	产品质量
productivity [ˌprɔdʌk'tivəti]	*n.* 生产率；生产力
profile ['prəufail]	*n.* 轮廓，外形
profit ['prɔfit]	*n.* 利润，收益，赢利；益处，得益
proliferate [prə'lifəreit]	*vt.* 繁殖；扩散
proportional [prə'pɔ:ʃənl]	*a.* 成比例的
proprietary [prə'praiətri]	*vt.* 先占有，先取
proximity switch	接近开关
pulley ['puli]	*n.* 皮带轮
pulsative ['pʌlsətiv]	*a.* 脉动的；跳动的
pump [pʌmp]	*n.* 泵； *vt.* 用泵抽吸扰；间歇地喷出
push button switch	按钮开关

Q

quality ['kwɔləti]	*n.* 质，质量；品质；特征，特性
quantity ['kwɔntiti]	*n.* 数目，数量
quotation [kwəu'teiʃən]	*n.* 引用，引述；引文；时价，报价

R

ram [ræm]	*vt.* 锤击；夯紧； *n.* 伸杆；滑枕；夯
rapid traverse	快速进给；快速行程
ratio ['reiʃiəu]	*n.* 比，比率

reassemble [ˌri:ə'sembl] *vt.* 重新组合，重新装配
recess [ri'ses] *vt.* 开槽；隐藏；使……凹进去
recondition ['ri:kən'diʃən] *vt.* 再生；重磨；修理，修复
re-direction 改变方向
refer to 参考；指的是；适用于；涉及
refine [ri'fain] *v.* 细化；改善；精练
register ['redʒistə(r)] *vt.* & *vi.* 记录；登记；注册
regulate ['regjuleit] *vt.* 控制
relay ['ri:lei] *n.* 继电器
relay module 继电模块
release [ri'li:s] *vt.* 发表，释放
renovate ['renəveit] *vt.* 翻新；修复；整修
replacement [ri'pleismənt] *n.* 代替；替换，更换
representation [ˌreprizen'teiʃən] *n.* （总称）代表；代表制；代理
representative [ˌrepri'zentətiv] *n.* 代表；代理人
resistance [ri'zistəns] *n.* 电阻
resistor [ri'zistə(r)] *n.* 电阻器
resizing [ri'saiziŋ] *n.* 尺寸再生
responsible [ri'spɔnsəbl] *a.* 有责任的，（应）负责任的
restriction [ris'trikʃən] *n.* 限制；节流
restrictor [ris'triktə] *n.* 节流阀
resultant [ri'zʌltənt] *n.* 合力；　*v.* 组合的，合成的
retain [ri'tein] *vt.* 保持，保留
reversal [ri'və:sl] *n.* 反向；反转；倒转
revision [ri'viʒən] *n.* 修正，修改
rigid coupling 刚性联轴器
robot ['rəubɔt] *n.* 机器人
roller ['rəulə(r)] *n.* 滚压机；滚杠，滚柱；定型卷夹
rotor ['rəutə(r)] *n.* 转子，旋转器；[物] 旋度

S

sandwich-type machining 双面加工
sapphire ['sæfaiə(r)] *n.* 蓝宝石；蔚蓝色
sawing machine 锯床
schedule ['ʃedju:əl] *n.* 安排，排定；时间表，日程安排表

science fiction	科学幻想
screw machine	车丝机，制镙钉机
sculpt [skʌlpt]	*vt.* 雕刻
seal [si:l]	*n.* 密封垫；*v.* 盖章
sectionalize ['sekʃənəlaiz]	*vt.* 分段，分布
sediment ['sedimənt]	*n.* 沉淀（物）
segment ['segmənt]	*n.* 部分，片段；瓣；[计] 程序段
selector switch	选择开关
sensor ['sensə(r)]	*n.* 传感器
sequential [si'kwenʃl]	*a.* 按次序的；相继的；构成连续镜头的
serendipity [ˌserən'dipəti]	*n.* 意外新发现；巧事
servo amplifier	伺服放大器
set up	建立；产生；引起；安装
severity [si'verəti]	*n.* 严格；严厉；恶劣
shaper ['ʃeipə]	*n.* 牛头刨床
shear [ʃiə]	*vt.* & *n.* 剪力，切力；切变；剪床
shrinkage ['ʃriŋkidʒ]	*n.* 收缩；缩水
sign [sain]	*n.* 标记，符号
silicon ['silikən]	*n.* [化] 硅
simulation [ˌsimju'leiʃən]	*n.* 模仿；模拟
simultaneous [ˌsiməl'teinjəs]	*a.* 同时发生的；同时存在的
single throw	单掷开关
slide [slaid]	*v.* 滑动；　*n.* 滑板，滑块
smart [smɑ:t]	*a.* 聪明的；敏捷的智能的
snapshot ['snæpʃɔt]	*n.* 快照
soak [səuk]	*v.* & *n.* 浸，泡
solder ['sɔldə]	*n.* 焊料；　*v.* 焊接
soldering ['sɔldəriŋ]	*n.* 锡焊，软钎焊
soldering copper	纯铜铬铁
solicit [sə'lisit]	*vt.* & *vi.* 恳求，请求，乞求
solidification [səlidi'fikeiʃn]	*n.* 凝固；固化
spare part	备件
specification [ˌspesi'fikeiʃn]	*n.* 规定，技术要求，规范；说明书，详细的计划书
specimen ['spesimən]	*n.* 样品；范例；试件

spelter ['speltə(r)] *n.* 硬钎焊料，锌铜焊料

spelter solder 硬焊料

sphericity [sferisiti] *n.* 球（形）度；成球形

spheroidal [sfi'rɔidl] *a.* 类似球体的

spindle ['spindl] *n.* 心轴，主轴

spring [spriŋ] *n.* 弹簧

spray-painting 喷漆

sprinkle ['spriŋkl] *n.* & *v* 洒，喷

sprocket ['sprɔkit] *n.* 链轮

squareness [skweənis] *n.* 垂直度；方（形）

stage [steidʒ] *n.* 阶段；步骤

standardize ['stændədaiz] *vt.* 使标准化，使规格化

standardized ['stændəˌdaizd] *a.* 标准化的

stearine ['stiəri:n] *n.* 甘油；硬脂

step out 失步，不同步

stepper motor 步进电机

stiffen ['stifən] *v.* 硬化

stipulate ['stipjuleit] *vt.*（尤指在协议或建议中）规定，约定

stipulation [ˌstipju'leiʃən] *n.*［不可数］规定；［可数］条款，条件

straightness ['streitnis] *n.* 直线度

strain [strein] *n.* 应变；拉紧；张力；变形

strategy ['strætidʒi] *n.* 战略，策略

stress [stres] *n.* 应力

strip [strip] *v.* 剥去； *n.* 带，条

stylus ['stailəs] *n.* 笔尖；唱针

sub-circuit [ˌsʌb'sə:kit] *n.* 支路

subcritical annealing 亚临界退火

subject [sekt] *vt.* 使受到

subsequent ['sʌbsikwənt] *a.* 随后的，后来的

superior [sju'piəriə] *a.*（级别、地位）较高的；（品质、程度）优良的，较好的

supervision [ˌsju:pə'viʒn] *n.* 监督，管理

surpass [sə'pa:s] *vt.* 超过，优于

synchronize ['siŋkrənaiz] *vt.* & *vi.*（使）同步；（使）同速进行

synthetic [sin'θetik] *a.* 合成的；人工制造的

T

tailstock ['teilstɔk]	*n.* 尾架；尾座
take advantage of	利用
tapered key	斜键；锥形键
technician [tek'niʃn]	*n.* 技术人员，专家；技巧好的人
technique [tek'ni:k]	*n.* 技巧，手法
technology [tek'nɔlədʒi]	*n.* 科技（总称）；工艺；工业技术
temporarily ['tempərərili]	*ad.* 临时
tendency to	……的倾向（趋势）
tensile ['tensail]	*a.* 拉力的，抗拉的，能拉伸的
tension ['tenʃən]	*n.* 张力，拉力
term [tə:m]	*n.* 术语； *vt.* 把……称为
terminate ['tə:mineit]	*vt.* & *vi.* 结束；使结束，使停止，使终止；解除（契约等）
terminology [ˌtə:mi'nɔlədʒi]	*n.* 术语，专门名词
territory ['terətri]	*n.* 领域，范围
the absolute pulse coder	绝对脉冲编码器
the sequence of operations	工序
the substitution of A for B	A 取代 B
theoretical [ˌθiə'retikl]	*a.* 理论的
three jaw universal chuck	三爪万能卡盘
thumbwheel [θʌmwi:l]	*n.* 拨轮
tighten ['taitn]	*vt.* 使变紧
timer ['taimə(r)]	*n.* 定时器；计时员
time-saving	省时的
timing circuit	定时电路
to act on	作用于
to bring about	引起；产生；导致
to speak of	提到，谈到
tool post	刀座，刀架
torque [tɔ:k]	*n.* 扭转力，转矩，项圈
transaction [træn'zækʃn]	*n.*（一笔）交易；（一项）事务
Transistor	晶体管
transport [træns'pɔ:t]	*vt.* 运送； *n.* 运输，运输工具

tremendous [triˈmendəs] *a.* 惊人的，非常的
triangular [traiˈæ ŋgjələ(r)] *a.* 三角形的
trigonometry [trigəˈnɔmitri] *n.* 三角（学）
troubleshooting [ˈtrʌbl ˌʃuːtiŋ] *n.* 发现并修理故障，故障检查
tumble [ˈtʌmbl] *n.* 翻滚
tumble jig 翻转式钻模；滚筒夹具
turbine [ˈtəːbin] *n.* 涡轮机
turn [təːn] *vt.* 旋转；车削
turn out 生产；制造
turning [ˈtəːniŋ] *n.* 车削
turret [ˈtʌrit] (= turret head) *n.*（机床刀具）转塔，六角（转）头
twin-turret 双塔刀架
turret lathe center 转塔式车削中心
typically [ˈtipikəli] *ad.* 典型地，具有代表性地

U

ultraviolet [ʌltrəˈvaiələt] *a.* 紫外（线）的
undergo [ˌʌndəˈgəu] *vt.* 经历；承受；遭受
undesirable [ˈʌndiˈzaiərəbl] *a.* 不合需要的
undulating [ˈʌndjəletiŋ] *a.* 波浪形的，起伏的
unexplored [ˈʌnlikˈplɔːd] *a.* 未被利用的，未开发的
uniform [ˈjuːnifɔːm] *a.* 规格一致的
unilateral [ˌjuːniˈlætrəl] *a.* 单向的
unload [ˌʌnˈləud] *v.* 卸载
unmanageable [ʌnˈmænidʒəbl] *a.* 难管理的
upstream [ˌʌpˈstriːm] *a.* 上游的
utilize [ˈjuːtəlaiz] *vt.* 利用；使用

V

valve [vælv] *n.* 阀
variant [ˈveəriənt] *a.* 不同的，各种各样的
variation [ˌveəriˈeiʃən] *n.* 变化；变动
vaseline [ˈvæsəliːn] *n.* 凡士林
vector [ˈvektə] *n.* 矢量；向量
verticality [ˌvəːtiˈkæliti] *n.* 垂直性，垂直状态

via ['vaiə] *prep.* 经过，经由
vibration [vai'reiʃn] *n.* 振动
viscosity [vi'skɔsəti] *n.* 黏性
viscosity index 黏度指数
viscous ['viskəs] *a.* 黏性的
vitally ['vaitəli] *ad.* 非常
voltage ['vəultidʒ] *n.* 电压，伏特数
volumetric [vɔlju'metrik] *a.* （测）容量的

W

warranty ['wɔrənti] *n.* 保证书，保单；授权
wastage ['weistidʒ] *n.* 损耗；损失
wear [weə(r)] *n.* & *vi.* 磨损，损坏
welding ['weldiŋ] *n.* 焊接，熔接
whatnot [wɔtnɔt] *n.* 类似的东西；诸如此类的东西
whelming [welmiŋ] *v.* 压倒
winding ['waindiŋ] *n.* 线圈；绕组
wiring machine 金属丝接合机
wiring out 布线图
wobble ['wɔbl] *vi.* 摇晃，摇摆
woodruff key 半圆键
work handing 工件传送
workpiece ['wə:kpi:s] *n.* 工件
wrapping ['ræpiŋ] *n.* 缠绕

Z

zinc chloride 氯化锌

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